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August
1930
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Taught to
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A giant Zeppelin not long ago started across the Atlantic. Hardly was it well under way, when, one by one, the drive shafts of four of its five engines cracked and went out of action. The great air ship turned back and landed—reaching its port just in time, as mechanics soon discovered, for the fifth shaft was then almost at the breaking point.

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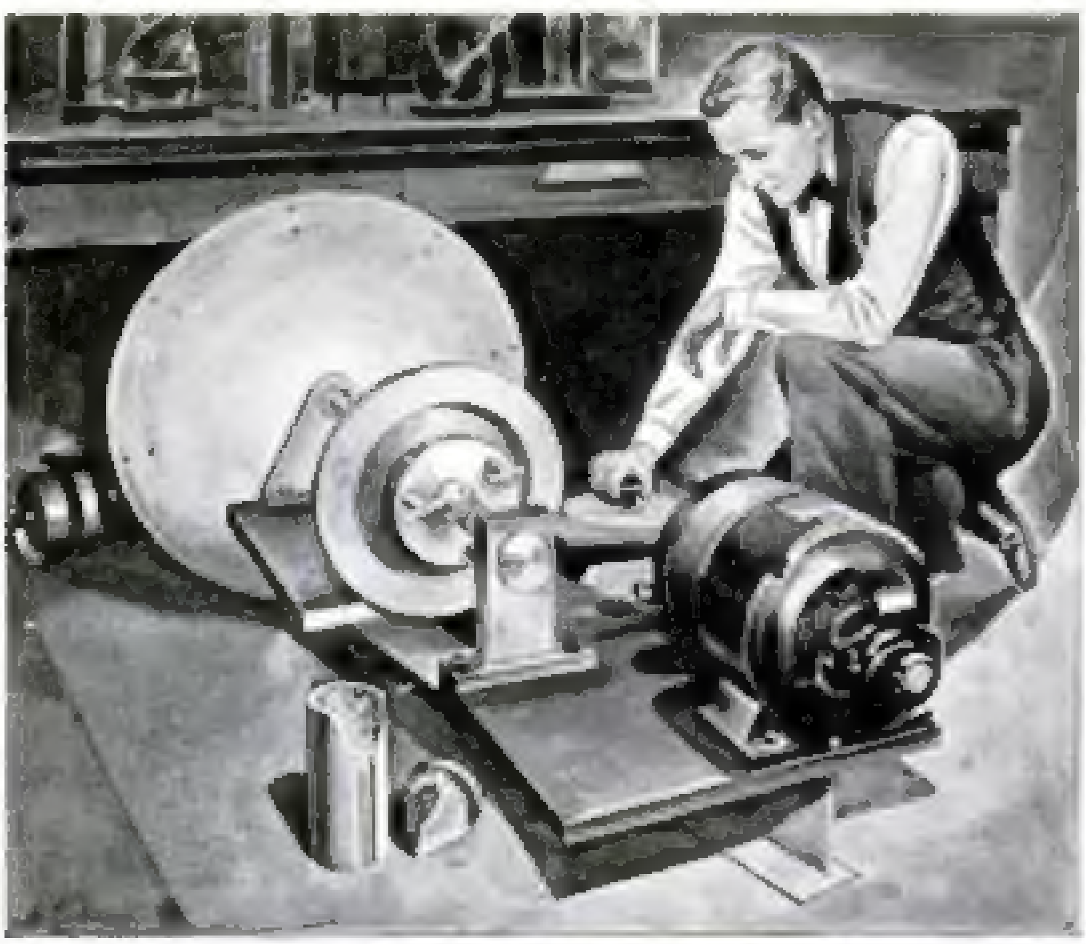

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Table of Contents for August, 1930

LEADING ARTICLES

FEATURES AND DEPARTMENTS

Automobiles

Aviation

Engineering

Health and Hygiene

Laboratory Discoveries

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Popular Science Monthly for August, 1930

Models

New Devices for the Home

New Processes and Inventions

Photography

Radio

Unusual Facts and Ideas

For the Home Owner

Craftwork

Woodworking

Ideas for the Handy Man

Hints for the Mechanic

How You Can Be Worth $50,000 More—Tomorrow

LEON MEADOW, *Financial Editor*

"OH MARTHA," shouted Peter Ransom as he crossed the threshold, home from another day's work, "where are you?"

"In the kitchen, dear," his wife called out.

Peter dropped his coat on the hall table, cocked an expectant ear for some greeting from his daughter, got none and proceeded into the kitchen for further investigation. "Where's Babs . . . asleep already?" Peter demanded, after the usual salutations had been exchanged.

"Yes, Peter . . . the poor thing was so weary that she practically fell asleep over her supper. She certainly had a big day."

"Oh, I almost forgot! How was the party?"

"One glorious success . . . only three fights and no spoiled stomachs. I'm too busy with supper to tell you all about it now. I'll give you all the details later."

But Martha never got a chance to describe the day's events that evening. Primarily, because Peter opened up the subject of finances at the supper table, and the discussion continued throughout the whole evening. Ransom had been thinking about his position in the world for a long time. He had juggled with his potential earning capacity and savings ability many an hour rightly belonging to sleep. Peter had mulled over in his mind a hundred ideas for increasing his present and future worth, only to reject them all upon the realization that the little he had was too valuable to be risked on any haphazard scheme, and by the same token too small to produce sufficiently big returns on gilt edge investments.

Now, at the end of a perfect day, his wife's happiness did not escape him. Perhaps it was Babs' birthday and the resultant peak of joy that thrust upon him the uneasy, vivid contrast of his not being there to provide for their happiness, should accident or illness prove fatal. Of course, from there it was but a single step to the thought of insurance. But proper, complete protection, from his meager knowledge of insurance, was out of the question on his present, or potential earnings for the next ten years. So the evening passed, as others had, with no solution to this problem.

Here the long arm of coincidence step into the picture.

The next morning Peter, hard at work, was interrupted by the ringing of the telephone on his desk. "Yes, Ransom speaking."

"Mr. Ransom, this is Jack Alton of the Ajax Mutual Life Insurance Company. I was in to see Mr. Appleton yesterday and he mentioned your name to me, so I took the liberty of this call. I'd like to show you how our plan will insure financial independence and protection for the salaried family man."

Peter did some rapid thinking. Appleton was his boss, and if he had mentioned his name to this insurance man, perhaps it would be wise to see him. "Well", he began, "I'm rather busy these days," . . .

"How about some evening when you're not engaged elsewhere? I think I can show you some mighty interesting facts about insurance."

"Let me see," replied Peter. "Suppose you come out to the house tomorrow evening about eight o'clock or so."

As Peter explained it the next evening, after a good deal of preliminary talk, he wanted Martha and Babs to be able to live at least as well as they were now—should anything happen to him. And at the same time, he would rather look at it the other way. He would rather think of himself as a living person, with some assurance of an income in his late years.

"Could all that be accounted for on an income of $2500 a year?" Alton asked.

"It would have to . . . and even the necessary capital to produce that is out of the question, no less thinking of a bigger income . . ." replied Ransom.

"Well then, as I see it, you'll have to set up an estate of $50,000 which, when safely invested at 5%—for utmost security—will bring your wife and child the necessary income."

"$50,000! I suppose you're going to suggest insurance," said Peter with some anger in his voice. "At my age that would stand me about $1000 in premiums. Over and above draining me of my last cent in savings, that $1000 happens to be almost double the amount I'll be able to put away each year for the next few years. So you (Continued on page 5)

Chart Referred to on Page 6

Age	Salary	Expenses	Surplus	Term. Ins.	Term. Prem.	Endowment Ins.	Endow. Prem.	Total Premium	Additional Saving at 4½% Compound Int. [illegible]*
28	$3000.00	$2400.00	$600.	$50,000	$500.00	....	....	$ 500.00	$1118.08
29	3250.00	2650.00	600.	40,000	332.40	$10,000	$209.00	541.40	1229.52
30	3500.00	2750.00	750.	35,000	290.85	15,000	338.85	629.70	1410.55
31	3500.00	3000.00	500.	30,000	249.30	20,000	404.40	653.70	1313.41
32	4500.00	3500.00	1000.	25,000	207.50	25,000	509.55	717.05	1668.20
33	4500.00	3500.00	1000.	20,000	166.00	30,000	619.05	785.05	1967.90
34	5000.00	3750.00	1250.	15,000	124.50	35,000	731.15	855.65	2408.58
35	5000.00	4000.00	1000.	10,000	83.00	40,000	848.40	931.40	2651.35
36	6000.00	4500.00	1500.	5,000	41.00	45,000	967.85	1008.85	3283.91
37	6000.00	4750.00	1250.	....	....	50,000	1092.70	1092.70	3586.00

*Balance in savings bank up to present.

How You Can Be Worth $50,000 More—Tomorrow

(Continued from page 4)

see, this talk is all very nice, but useless. I've figured it out myself too often these last few months to kid myself. I'm just up against it for the present. I'll have to take my chances."

"Ransom, you're dead wrong! You can do it, and without cleaning out your savings. Let's get down to figures. What will your savings be this year?"

"Oh, approximately $600," said Peter, with a very small measure of interest.

"Good," Alton came back. "Can you expect that and more for the next nine years?"

"Well—yes, I suppose so. I seem to be set pretty well at the office. Far as I know, a few years will see me going steadily up the ladder and my savings should increase appreciably. But what are you driving at with this talk of salary and savings—and how in heaven's name can I pay such staggering premiums?"

"First answer this question: Did you ever hear of term insurance?"

"Yes, but in a hazy way. Just what is it?"

"Briefly," Alton explained, "it is insurance that gives you the greatest possible protection at very low premiums—over a certain period."

"Which is?" Peter interrupted.

"Well, in our case, 10 years. If term insurance is allowed to lapse without being converted into some other form of insurance, the policy expires and you are no longer covered. But term insurance of our type can be converted at the beginning of the tenth year—or sooner, if you wish. Here's the big point. $50,000 worth of term insurance will cost you $11.21 per thousand or just about $560 in premiums the first year, whereas ordinary life, the cheapest form of permanent insurance, would figure out $1084.50 premium on $50,000."

"Wait a minute, Alton! Do you mean to tell me that I can carry $50,000 worth of insurance, that amount of protection for $560 a year?"

"Less than that—when you subtract the dividends at the end of the first year and each year thereafter. But remember that it must be converted within the stipulated period to be of any value to you beyond protection for the 10-year term. And also, that conversion to other types of insurance will raise the premium accordingly."

"I understand that," broke in Peter, impatiently, "but my salary increases should take care of that all right. Say, let's work this whole thing out over a ten-year period, with approximate figures for salary and expenses each year. But first, to what type of insurance do you suggest converting the term policy?"

"I'd say annual endowment at age 70. That will assure you of independence and a permanent income when both your earning capacity and need for insurance are on the down grade. Anyway, for the sake of planning a conversion chart, let's figure an age 70 endowment now. You don't have to decide definitely till your first conversion. (Continued on page 6)

How You Can Be Worth $50,000 More—Tomorrow

(Continued from page 5)

"We ought to be able to work this thing out so that you can convert a certain amount of term insurance each year and avoid paying a suddenly doubled or tripled premium at one time."

For the next forty-five minutes the two men were lost in a sea of figures, and the only words that broke the silence were numbers. Finally they emerged with a table of figures that looked like the chart on page 4.

"Notice this, Ransom"—Jack Alton pointed out, "at the second year, when you're 29, you will see that your total premium is $18.60 less than that of the first year, although you have already converted $10,000 to endowment insurance, on which there is a higher rate. That's just a striking example of what first year dividends plus reserve value on that $10,000 worth of converted term insurance will do in this one instance. Naturally, as more is converted, the higher premiums on endowment insurance over-balance the reduction by dividends—but then, let the figures speak for themselves. Over 10 years you will have been fully protected—and established by that time in a financial position that will enable you to carry $50,000 worth of endowment insurance—the foundation of an estate. Moreover, these premiums have not drained your resources. To the contrary your bank balance will have increased about $2500 at the end of ten years!"

"An increase of $2500," repeated Peter Ransom. "Gee, Alton—I didn't think it was possible. That alone is enough to see my daughter through college! I can't believe it."

"It's in the figures, Ransom—the whole story at a glance. You come down to my office tomorrow and we'll put you through a medical examination and fix up the papers."

"All right Jack—I'll be there," Peter said good-night, closed the door and walked upstairs surprised and happy, like a man whose mind has just been relieved of a great burden.

* * *

Thousands of men like Peter Ransom, are anxious to assure themselves and their families a good financial future. The chart that the insurance man worked out with Ransom is based on the premium rates, dividends and conversion period of a large mutual insurance company, and is similar in most respects to the term policies issued by most reliable insurance companies.

It must be realized that the true value of term insurance goes beyond ten years maximum protection at minimum rates. The importance of this cannot be emphasized too strongly. For in the last analysis it is the type of insurance to which the term policy is converted that really determines the wisdom of the investment. In this case age 70 endowment insurance was chosen. It is but one of the many plans by which life insurance and financial security may both be gained.

How You Can Be Worth $50,000 More—Tomorrow

(Continued from page 6)

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 318 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

A Service for Readers

THIS Financial Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it.

The Editor of this Department is ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address your inquiries to Financial Editor, Popular Science Monthly, 381 Fourth Avenue, New York. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

INDEX
Guaranteed Advertisements

Automobiles and Accessories

Aviation

Building Materials

Business Opportunities

General

Hardware Supplies

Industrial Equipment

Investments

Miscellaneous

Musical Instruments

Patent Attorneys

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

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Refrigeration and Your Health

Germs, some of which are dangerous, multiply fast in temperature above 50. So test your refrigerator.

By F. G. PRYOR

Secretary, Popular Science Institute

HOW to keep food from spoiling always has been a big problem. Drying, smoking, or pickling was the way it was solved in early days, but the trouble was these methods changed the taste and characteristics of the food. Finally, it was found that by removing heat, food could be kept for a long time without losing any of its natural qualities.

Caves and springs were the first means of refrigeration and later "cold cellars" came into use. Just how cool these places had to be in order properly to preserve food was a question that no one knew or particularly cared about, so long as the food did not mold too fast.

TODAY we know that *below* 50° Fahrenheit lies safety. Germs multiply at a greater rate when refrigerator temperature gets above 50° Fahrenheit. Usually this means spoiled food with consequent waste. Often it means that food is eaten which is really harmful. Most bacteria are not dangerous but, should it happen that typhoid bacilli were among the rapidly multiplying germs, someone in the family might get a bigger dose of these germs than he is strong enough to resist. Taste is not a safe guide, for a test was made recently with five people, all of whom were given chicken soup in which bacteria had multiplied 1,400 times, and not one found fault with the flavor.

That refrigerator temperatures much above 50° F. are dangerous is not a fanatical notion but a fact on which there is general agreement among Government authorities and refrigeration experts. The Federal Government has for some time issued rigid requirements regarding the temperature at which food must be kept during storage and transportation. Public health officials are trying now to impress upon the public the importance of equally careful preservation of perishable food after it has reached the home.

Take, for instance, the care given meat and fish. Such products travel hundreds of miles to their destination in a refrigerator freight car that automatically maintains blizzard temperature within. Then they are transferred to motor trucks with efficient built-in refrigerators, and from these they go to sub-zero cabinets in retail stores. After all this care these products frequently end up in a household cabinet that does not even deserve the title of refrigerator. It seems rather illogical that the people who actually *eat* the food should be much less interested in keeping it in good condition than those who only *handle* it.

TO KEEP perishable food in the home safely, it is necessary to have something more than a good looking and nicely lined refrigerator. First of all, it is necessary that the box be properly insulated with a substantial layer of corkboard or its equivalent, two inches being the most desirable thickness for such insulation. Next, it is essential that the box be properly designed, since interior construction has a very definite effect on air circulation and the general efficiency of the refrigerator.

A GOOD refrigerator properly cared for will maintain an average temperature in the milk compartment of not over 45° Fahrenheit and in the large food compartment the average will not be over 50° Fahrenheit when the outside temperature is at 75° Fahrenheit or under. If the refrigerator is one of the ice type, proper care consists in always keeping the ice compartment at least one half (preferably two thirds) full. And the ice should not be covered.

The practice of wrapping ice with newspapers, which is followed in some households, prevents free circulation of air about the ice. Not enough ice is exposed to fully refrigerate the food compartments, also the entire surface of the ice cake is needed to absorb the food odors carried by the air.

Tests made on a good grade refrigerator in a room whose temperature was at 76° brought out the following results.

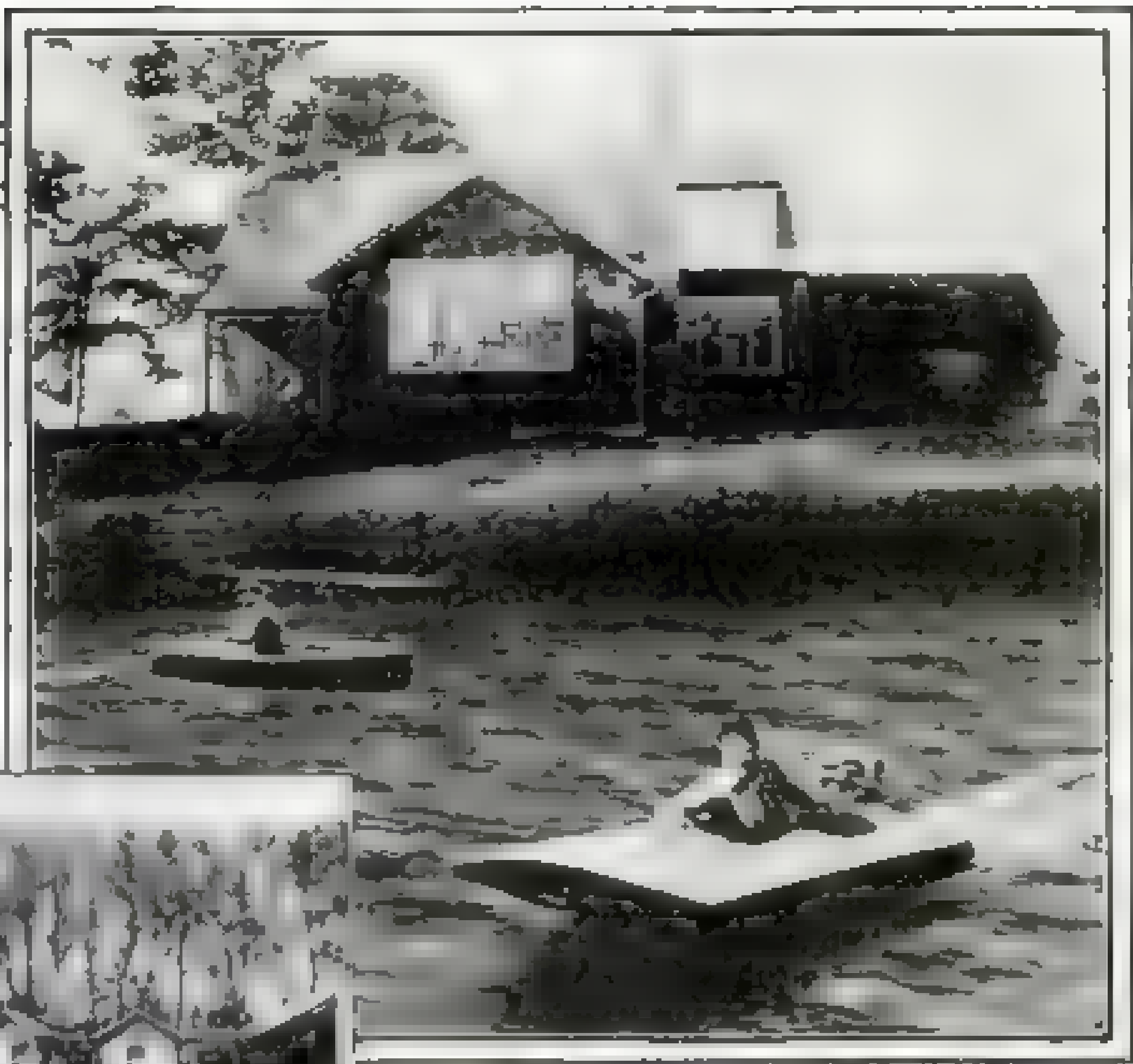
When the ice was unwrapped, twenty-six pounds were melted in twenty-four hours. Keeping the same box in the same room temperature for twenty-four hours with the ice *wrapped* showed an ice meltage of twenty-three pounds. The refrigerator temperatures in the various compartments were consistently higher throughout. These results demonstrate that three pounds of ice a day may be saved by wrapping the ice cake, which means a daily saving of less than two cents. Offsetting this money saving is the increased refrigerator temperature and its consequences.

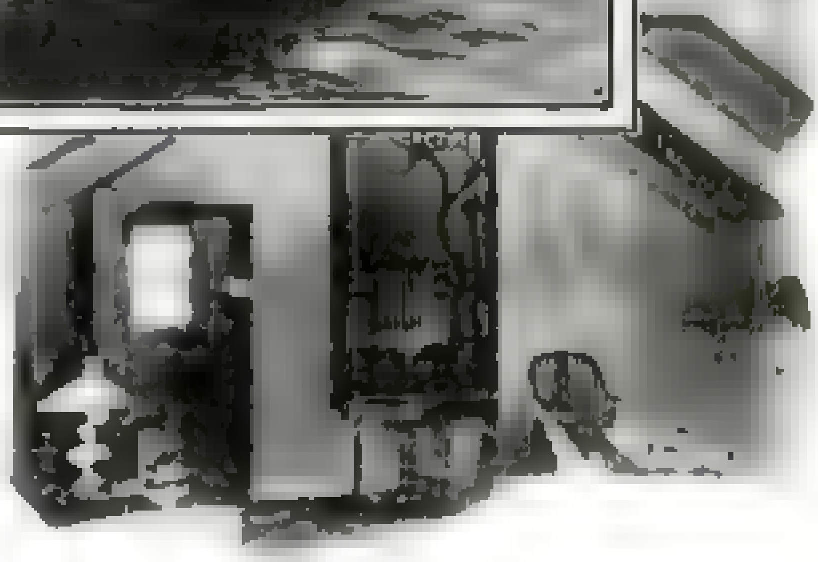
A good refrigerator, kept in good condition, is one of the best household investments, and more homes will be so equipped when the importance to health of proper food preservation becomes better known.

INSTITUTE BULLETINS

- Refrigeration for the Home*
- House Heating and Ventilating*
- Insulation in Building Construction*
- List of Approved Tools
- List of Approved Radio Equipment
- List of Approved Oil Burners
- Advice on Installing Oil Heat

*Starred bulletins 25 cents

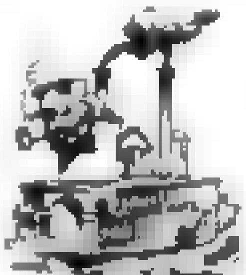




Our Readers Say

Our Ancestors Still Govern Us

You sort of poked fun at some of the primitive peoples who still do things just as their ancestors did. What about us? Are we really any better in that respect? What's more primitive than a ferry, and yet it's still widely used for no earthly reason, as far as I can see, except it was the best our ancestors could devise and so it's good enough for us. Tunnels and adequate bridges beat it a mile—and yet habit keeps the thing in use. And how about our Presidential electoral college? Any good to us? Dead as a doornail but still in use—for habit's sake. And why do we, in this age of swift travel, elect a Congress in November that doesn't take office for nearly fourteen months after election. And a President in November who doesn't get on the job until the following March? Sound sensible? Sound just plain coocoo to me. But our ancestors did it that way! How about getting rid of your own beam before you go after the other fellow's mote?—G. O. V., Lincoln, Neb.



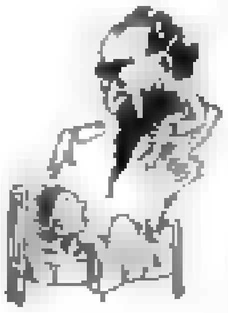
Debunking Ignorance His Favorite Occupation

The name of your magazine is almost an answer to what one should expect of the contents. Personally I like the articles that take the "bunk" out of popular conceptions, or the scientific truth and its relation to humanity. The article on [illegible] trade sounded like the truth, in fact, it gives one a better understanding of what he drinks nowadays. What I like is for you to tell the truth, whether about radios, horse racing, or public morals. The public is constantly endangered with all kinds of luring ads, and it is hard to tell just what to buy or to do.

Of course you must protect your advertisers but your reading public probably needs more protection. If the magazines and newspapers would acquaint the buying public with the real worth of articles being advertised, it would cause the manufacturers to build better and take a more honest interest in their product. I also like your radio section, I have read more real common sense in those pages than in any other publication dealing with the subject of radio.—W. S., Millvale, N. J.

More Light Wanted on Hypnotism

I enjoyed your two articles on hypnotism in the March and May issues immensely. I never thought much about it until I read Professor Wells' article in the March number, and now after reading Mr. Blackstone's article I am again in doubt. Please tell Professor Wells and Mr. Blackstone that I would like to hear more of their controversy.—J. C. W., West Salem, Wis.



Stickler for English Gets Caught Napping

May I correct the incorrect use of English in D. B.'s correction of the incorrect use of English in your April test? At the top of page 16 we read "Everybody nobody anybody, and somebody all of which are, in truth, one word." As a matter of fact the four words are four words. The correct statement is, "Each of which is, in truth, one word."—C. F. W., Pawnee Rock, Kan.

Anti-ash Reader Boosts Good Old Oil

Just a word in reply to S. B. M. and his good old ashes. I guess he is one of those coal dusters who has never been any farther than Wilkes-Barre and so doesn't know what a real good oil burner or heater is. It's ridiculous to hear him say, "Me for the anthracite, the good old clean, safe, silent fuel." Doesn't he know that there are oil burners and heaters on the market that are better than coal ever was or will be? They are not only clean, silent, and safe, but also cheaper in the long run. There is no noise, no gas, no smoke, and you don't have to carry the coal in and the ashes out. Besides, they are fully automatic and control the heat so as to keep an even temperature all the time. Has S. B. M. ever seen any coal that can do that? It would pay S. B. M. to get out once in a while and see just what the oil burner really is. I might add that in a very few years the only place coal will be used will be in the public museum, to show the coming generation what was once used for fuel.—W. W. H., New York City.

Good Enough Just as It Is Now

Although I know nothing of manual work, and could not tell one tool from another, I find your magazine the most interesting one I have ever read. Since I subscribed last year, I have enjoyed every article in the first section of the magazine. If Popular Science Monthly keeps up the good articles of the past, I see no need of a preponderance of any special subject as many readers urge. It suits me as it is.—C. P., Medford, Mass.

Resistance of Air Cuts Object's Falling Speed

Replying to R. W. H.'s gravity question. *Falling in a vacuum*, any object will continue to gain speed at the rate of 32.2 feet per second. However, in the earth's atmosphere a freely falling body eventually generates enough friction with the air to counteract the accelerating force of gravity. It then continues to fall at a constant rate. It is obvious that the velocity at which acceleration ceases depends on the density of the falling object. A bullet would continue to accelerate for a much longer period of time than a crumpled piece of paper.—P. L., Newark, N. J.

All Right, H. H., You Brought It on Yourself

It is my opinion that H. H. of Illinois doesn't read much, because he sure did prove it when he said a monorail train would fall over on its side when it came to a stop. Perhaps H. H. is one of the unfortunate few who hasn't a chance to read up on the latest inventions. Of course, this isn't a late invention, it is so old that H. H. should have read of it by this time. As for the airplane being a safe means of travel I don't think it needs to be much safer. I think H. H. will get an eyeful when he sees those lighter-than-air ships being built at Akron.—C. W., Renovo, Pa.

He's Airminded and Proud of It

I want to tell you how much I like Popular Science Monthly, especially the articles on aviation and best of all the personal experiences of pilots, such as Assen Jordanoff. Keep it up, in spite of the few old fogies who think there is no such animal as aviation. Live up to your name, and if aviation isn't a science I miss my guess.—W. H. W., West Reading, Pa.

Soften Your Bones and Tie 'Em in Knots

I suggest that you add to your "What's Wanted" list the following: A safe, painless, practical, cheap, and quick means of softening any part of the human skeleton so that it can be repaired, straightened, and brought back to a normal state. Surely Popular Science Monthly cannot fail to see what a real blessing this would be. Bow legged or knock kneed people could have their legs straightened; those who would like to be taller perhaps could have their bones stretched, and those who were too tall could have their bones pressed shorter; bad kinks could be taken out of the spinal column.—A. V., New York City.

Radio Plays Its Part; So Does Chemistry

Some time ago a discussion was raised in your magazine as to whether or not you were publishing too much on aviation. Many interesting letters were written on the subject, but did you ever think that possibly you were not publishing enough material on other forms of science? Did you ever happen to consider that chemistry is a science? That radio is a science? Many young people are interested in aviation, which at present holds a good future for any ambitious young man, but is it not true that

graduates from the aviation schools may soon be so numerous that the field will be overcrowded? Chemistry is a subject that appeals to many and interest in it can be counted on to last for years. Hope you won't feel that I'm an old grouch. H. R. B., Philadelphia, Pa.

That Airplane Problem Explained Again

T. R. L. reminds us that the problem of the airplane lift was never satisfactorily explained. He asks us to accept the theory that it is nothing but atmospheric pressure added to wind velocity from beneath that raises the weight of the plane into a partial vacuum above. If atmospheric pressure and vacuum were all we had to deal with the problem would be simplified and his solution would be correct, but we have the velocity of the wind on both sides of the wing, which causes a lift on the upper side greatly in excess of the push from the under side. All advanced students in this science know this to be true. An interesting experiment is to fold a piece of writing paper and roll one half of it to the shape or camber of an airplane wing. Blow along the upper surface only of the flat section and when the air strikes the front of the curve it advances against the wind instead of being depressed as one would expect. It is impossible to drive it back, the harder you blow the more it rises and advances. This is not caused altogether by atmospheric pressure from below. —A. E. J., Montreal, Can.

That Old Sound Question Gets an Answer

It was asked in Popular Science Monthly by W. E. P. L., if a cannon were fired in a desolate region where there were no persons within a radius of fifty miles, would there be a sound?

Sound may be defined as a sensation produced by sound waves set in motion and striking against the tympanum of the ear. Taking this definition of sound, the firing of the cannon would cause no sound because no sensation could be produced if no tympanum was present for the air waves to strike.

In physics, sound is described as that form of vibrational energy which occasions the sensation already described. Taking the latter definition sound would be present, in spite of the fact that there were no ears to "hear" because the vibrations would affect the sound produced. The question resolves itself into one of definition.—E. G., Norwood, Ohio.

Farmer Applauds Plant Pill Miracle

Much obliged for the "plant pill" article. I remember the first one you had about a year ago. The miracle worker seems to be getting on. That's the kind of stuff we farmers like, and you don't give us any too much of it. Come again soon. By the way, can't you stir up Dr. Gericke and get him to loosen on that pill so we can all get some bumper crops—even if the prices aren't anything to get excited about? Wish you'd try and the sooner the better. Anyway, out here, our hats are all off to Gericke. Long may he reign with a pill in each hand. And you, too, for giving us this important dope.—J. B. W., Thompson, Iowa.

Eight Ship Models Clutter Living Room

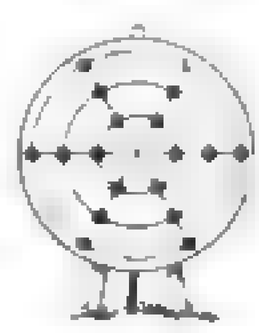
Acting on your advice, I wrote to the National Advisory Committee on Aeronautics. It has helped me greatly, in fact, to such an extent that I am the founder and secretary of the largest glider club in Queensland, and we have a primary glider of thirty-five foot span. You will remember I built five models of ships from the Home Workshop section. I now have eight models. Although I have done a lot of work on gliders, I cannot leave the models alone, so I am writing to ask you to send me the blueprints of the "Tally Ho" Stagecoach. I would like to say that the coach is one of the finest models I have seen. I have had extensive experience in coach work and wagon building and I am in a position to know. If the wagons and coaches are all equal to the Concord, I think I will be dropping Captain McCann and signing up with Mr. Love, but I will always be deeply grateful to Captain McCann. You can imagine eight boat models rather clutter up a living room.—S. T. F., Queensland, Australia.

Pioneer Flyers Made Airplanes Safe

Commenting on Jordanoff's articles in your magazine, A. L., New York, in the June number asks a question which I feel is unjustified. The hazards of early aviation cannot be denied, yet from each crash and each escape came the knowledge that is the foundation of present-day aeronautics. Aviation today is safer than anyone ten or twenty years ago could conceive. Air travel is safe and practical as a result of the sacrifices that men of Jordanoff's type made in years gone by. I for one am glad to read such articles, as they give me a keener insight into the lives of the pioneers.—F. R. V., Aniwa, Wis.

You Can Have a Lot of Fun with This Puzzle

A party of archers went out one day for target practice. After they had finished it was noticed that eighteen arrows had struck a target so as to form a symmetrical design. One of the party drew circles and diameters as shown in the picture. He indicated each "hit" by means of a large dot. He challenged the other marksmen to assign number values from one to eighteen inclusive to each "hit" so that the totals added across each diameter and around each circumference would be the same. Now you try it!—A. H., Brooklyn, N. Y.



Was This a Case of Hypnotic Suggestion?

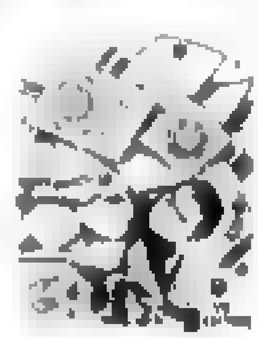
Reading Mr. Blackstone's article on hypnotism and strong suggestion reminded me of an example of this which I witnessed some years ago, that proved to be quite unfortunate. A star performer of a certain western college gymnasium team was practicing an elaborate and spectacular exercise on the high horizontal bar. He was doing very well and had attracted the attention of a group of gymnasts who were some distance away. One person in the group remarked to the rest, as they watched the performer whirl around, what a terrible thing it would be if he should suddenly let go. "Let go in such a position as that," said the speaker emphatically as the boy swung upward. The next thing anyone knew the gymnast had left the bar and was flying through the air. The fall resulted in a badly injured foot. Perhaps this will interest other readers of Mr. Blackstone's article.—C. H. T., Chicago, Ill.

Here's a Problem Not Easy to Solve

A problem I want solved is this. I buy Popular Science Monthly and bring it home. When I go to look for it, I find the whole family after it. My brother wanted to know where the jokes were and I told him to look at "Our Readers Say." Also I want to ask you to publish some articles about music because, after all, it's just science.—W. M. C., Pittsburgh, Pa.

That Revolving Cage Proved To Be No Joke

The ball bearing problem by J. R., Bozeman, Mont., can, of course, be solved in several different ways. The simplest is to consider it as a problem in levers. Since the cage is supported by the centers of the balls, which are at all times at the exact center of the space between the shaft and the outer race, any motion by the surface of the shaft will result in half the same amount of motion by the centers of the balls. In one revolution the two-inch shaft will move 6.2832 inches of surface (the circumference) past any given point. The centers of the balls will move half that far or 3.1416 inches. However, the centers of the balls move in a circle two and one half inches in diameter, which has a circumference of 7.854 inches, so it is only necessary to divide 3.1416 by 7.854 inches to get the portion of a revolution the cage will make. The answer is .4 inches.—A. P. A., New York City.



Oh, a Wonderful Bird Is the Pelican

An article in Popular Science Monthly said that no use for the curved end of the pelican's bill had ever been discovered. Anyone familiar with the habits of these fish-eating birds can account for the shape of the bill. If the bill had no curved end its width and length would severely strain the bird's muscles when the bill is plunged into the water.—A. J. O., New Orleans, La.

Eager to Fly, but a Trifle Nervous

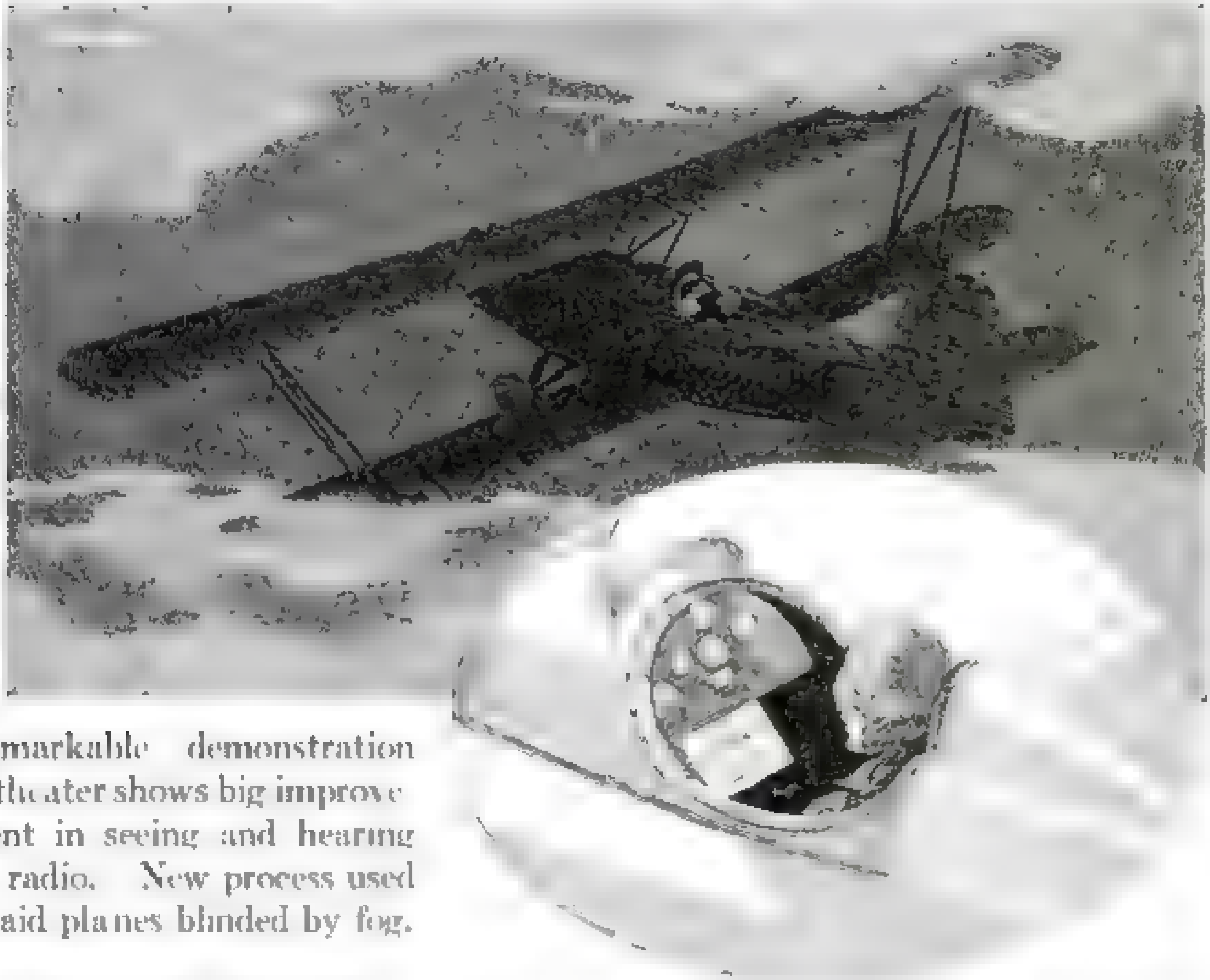
What we air minded fans want is an automatic parachute. It may be all right for Buddy Bushmeyer to step off on nothing and pull his rip cord when the notion hits him, but when I think of doing that my toes all curl up on me and I know I'd either never pull or pull too soon. If we had a parachute we could depend on to open of its own sweet will, we wouldn't be so scary. Some of you inventive birds should be able to work that one out. I liked Buddy's parachute story fine, but believe me more than once it made the old flesh creep.—R. C. M., Milbank, S. D.

Popular Science MONTHLY

FOUNDED 1872 — FIFTY NINTH YEAR

AUGUST, 1930 — RAYMOND J. BROWN *Editor* — VOL. 117, NO. 2

Mystery Cell Aids Television



Remarkable demonstration in theater shows big improvement in seeing and hearing by radio. New process used to aid planes blinded by fog.

By ROBERT E. MARTIN

Flying blindly through a fog, the pilot of an airplane will see on a screen before him images of the airport field and the outlines of all obstructions that may be in his path.

TWO remarkable developments recently revived public interest in television, and brought the dream of practical transmission and reception of "images on the air" a step nearer realization.

In a dramatic demonstration at Schenectady, N. Y., a few weeks ago, Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company, projected six-foot images bright enough to be seen by a large gathering. Before that the best television image had been only a few inches square and had been produced by the feeble flickering of a neon tube.

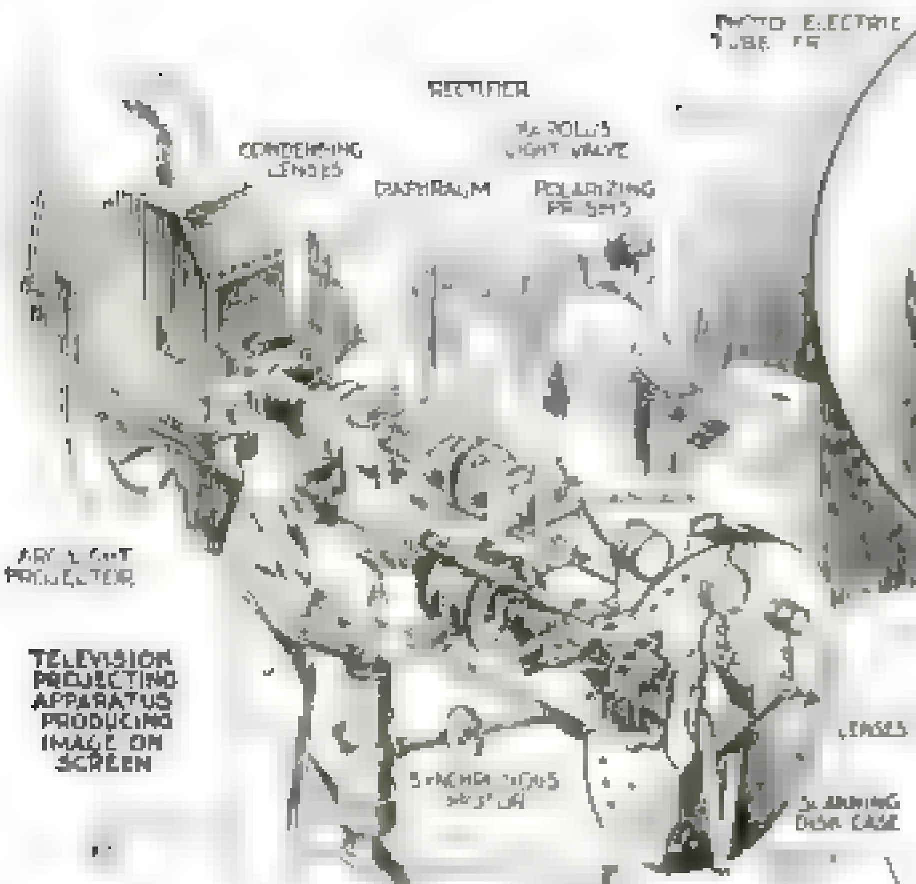
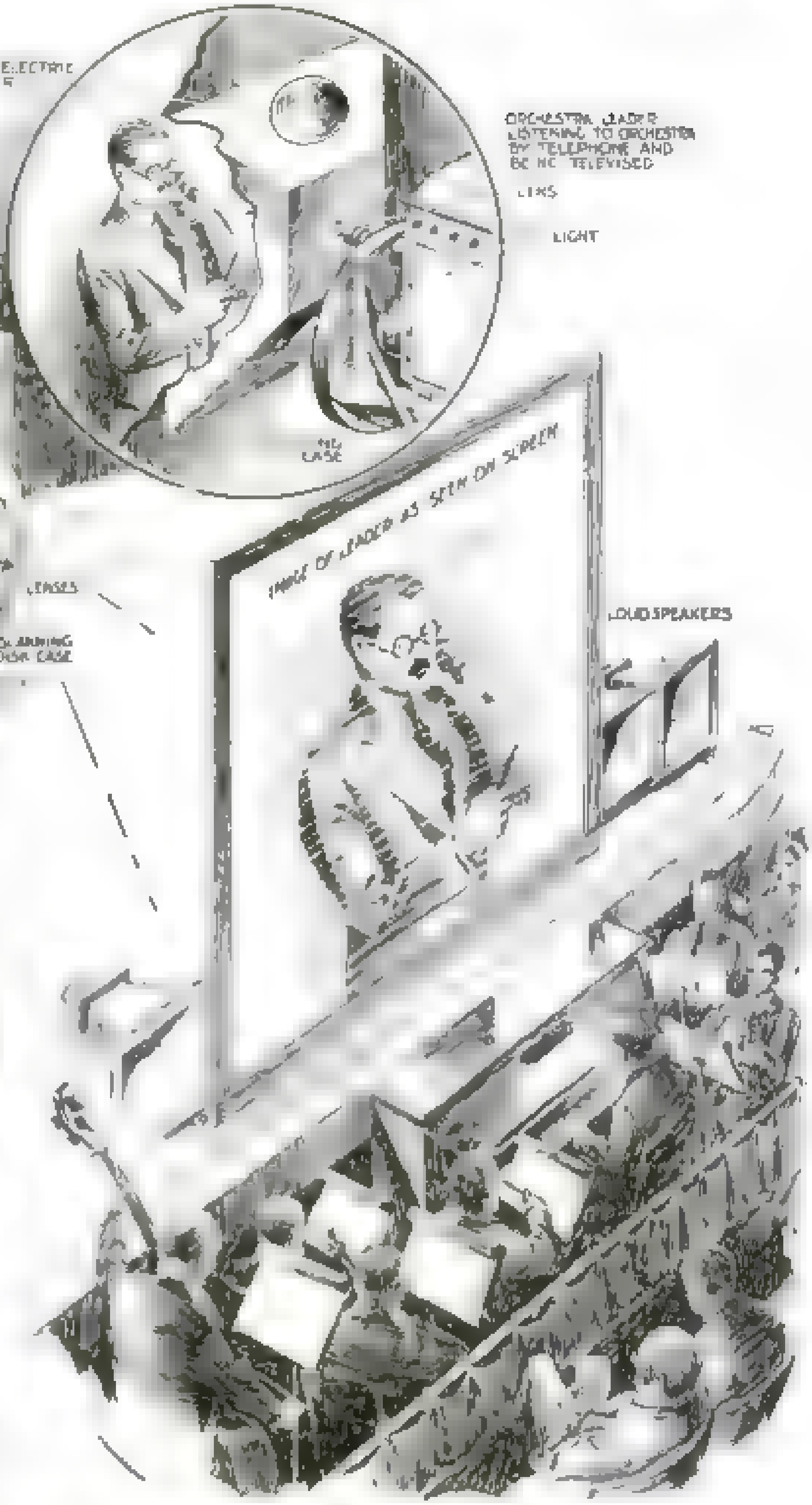
On the heels of Alexanderson's exhibition came an announcement from the Gloucester, Mass., laboratory of John Hays Hammond, Jr., known for his radio research work, to the effect that he had adapted the principles developed by Alexanderson to a system of television for use in aviation. This may make landing in a thick fog, now the most difficult and dangerous feat in aerial navigation, a simple and safe procedure.

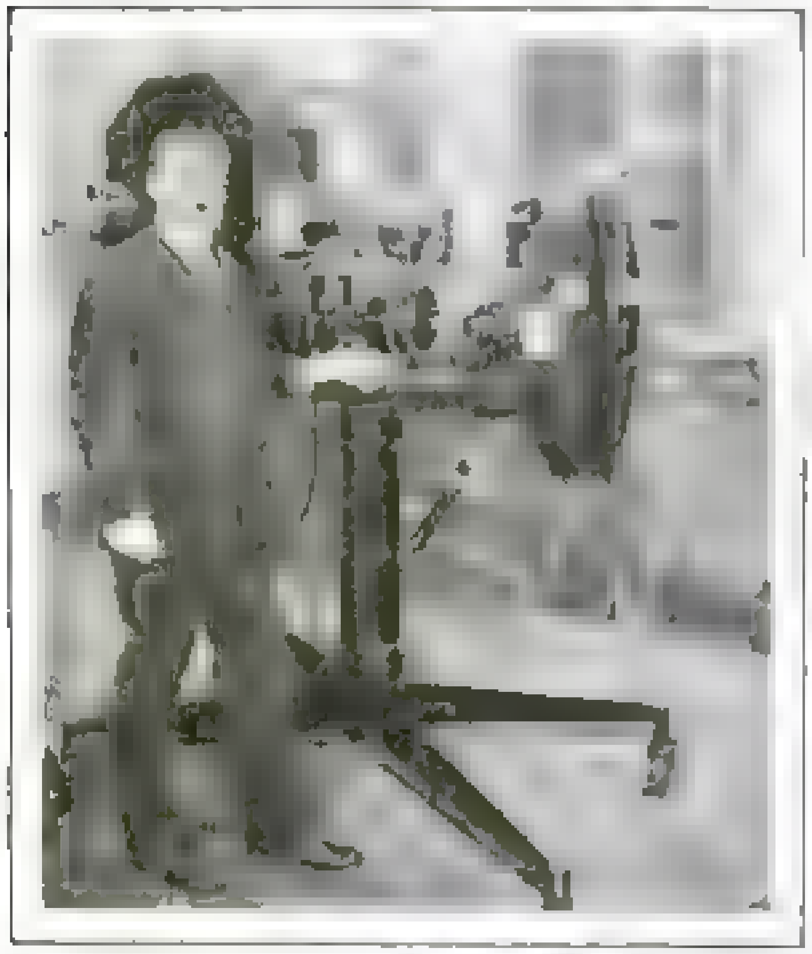
These new developments followed, by about a month, the demonstration of two-way television given at the Bell Telephone Laboratories in New York City (P. S. M., July '30, p. 22). While this revealed nothing really new, it showed that with suitable apparatus it is possible for both parties to a telephone conversation to see as well as hear each other.

In Schenectady, radio television made its debut as a public "performer." Alexanderson's demonstration took place at a vaudeville theater, where it was the "headliner" for one day.

As the curtain went up for this unique act, the stage was bare of scenery. Its center was occupied by a six-foot white screen, flanked on each side by a radio loudspeaker. Back of the screen, unseen by the audience, stood some complicated apparatus arranged in units on wheeled stands.

When the theater was darkened, a bright greenish glow appeared on the screen. It was projected from the television receiving equipment behind it. The glow became streaked with flying dots


This is the television receiver, being operated by Dr. E. F. W. Alexanderson, which projects on a screen the picture that has been picked out of the air as seen in the drawing at the right

which soon cohered into the life-size image of a pretty girl who sang a popular song in a studio a mile away. There her voice was broadcast in the usual manner by radio, while her image was "put on the air" by radio television. She heard by telephone the orchestral accompaniment being played in the theater.

The telephone again came into play in the next number, a team of black-face comedians who put on a novel television stunt. One of them was in the television studio and his image appeared on the screen in the theater. His partner stood beside the screen while they ran through their patter and songs together. The voice of the televised member of the team, like that of the girl in the preceding number, reached the audience by way of the loudspeakers on the stage, while the voice of his partner was transmitted to him by telephone.

Following a couple of similar acts came the climax of the demonstration. Upon the screen appeared the image of the orchestra leader who, holding a short baton in one hand and clasping the telephone to his ear with the other, stood in the studio a mile distant. As the shadowy conductor on the screen raised his baton, the flesh-and-blood musicians in the orchestra pit of the theater came to attention.

"Now, boys," said the leader, "let's have the overture. And put some pep into it!" A flourish of the baton and the boys launched into the opening bars of the selection. This was the first time in musical history that an orchestra had been conducted by a leader a mile away!

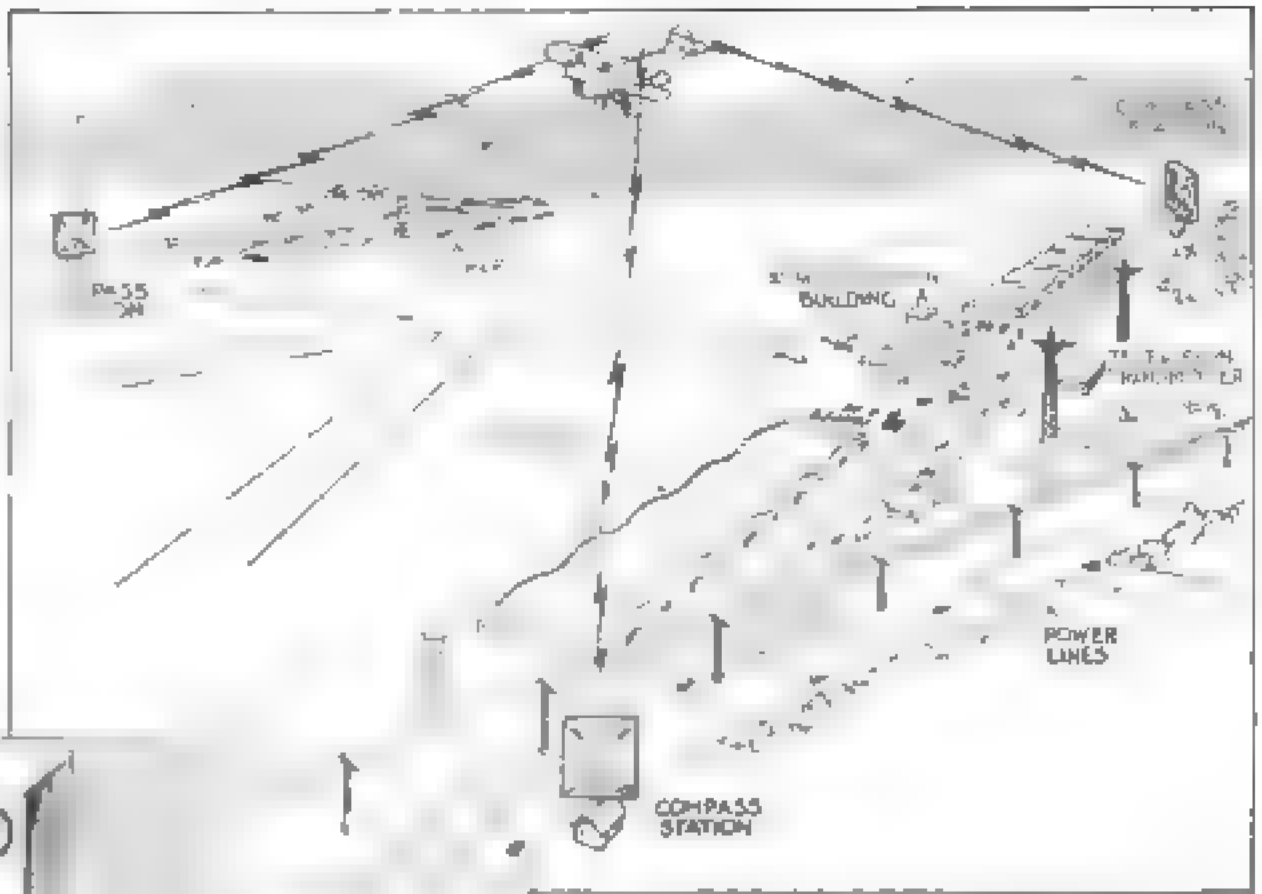
In the studio, the transmission of images was accomplished in the usual manner. Basically, the television broadcasting process consists of transmitting, with great rapidity, streaks of light and shade which form on the screen a complete image (P.S.M., Mar. '27, p. 37).

The brightly illuminated person or object to be televised faces a scanning disk, a round metal plate provided with a number of holes arranged in the form of a spiral. As this disk revolves, the light from the image behind it is broken up into individual rays that fluctuate in brilliancy to correspond with the light and dark areas, each time covering a different section, in other words, "scanning" it. Each hole in the disk represents one horizontal line of

the picture and, of course, one complete revolution of the disk constructs a complete image.

As the scanning disk rotates, the light and dark portions of the horizontal section of the image are translated, by means of a photo-electric cell, into corresponding electrical pulsations. These impulses are sent by radio to the receiving apparatus and there amplified and translated back into light vibrations. In Doctor Alexanderson's demonstration, the disk had forty-eight holes and rotated at twenty revolutions per second.

So far, there was nothing really new in the experiment. It was at the receiving end that the new development was brought into play. In the usual television receiving apparatus, the amplified electrical impulses cause a neon light to flicker. This light is intercepted and broken up by a second scanning disk the holes in which correspond to those in the disk at the transmitting end, so that each horizontal strip of light produces on the screen the same gradations of light and shade.



Here is the real airport, with the three compass stations designed to pick up the continuous stream of radio waves sent out by plane.

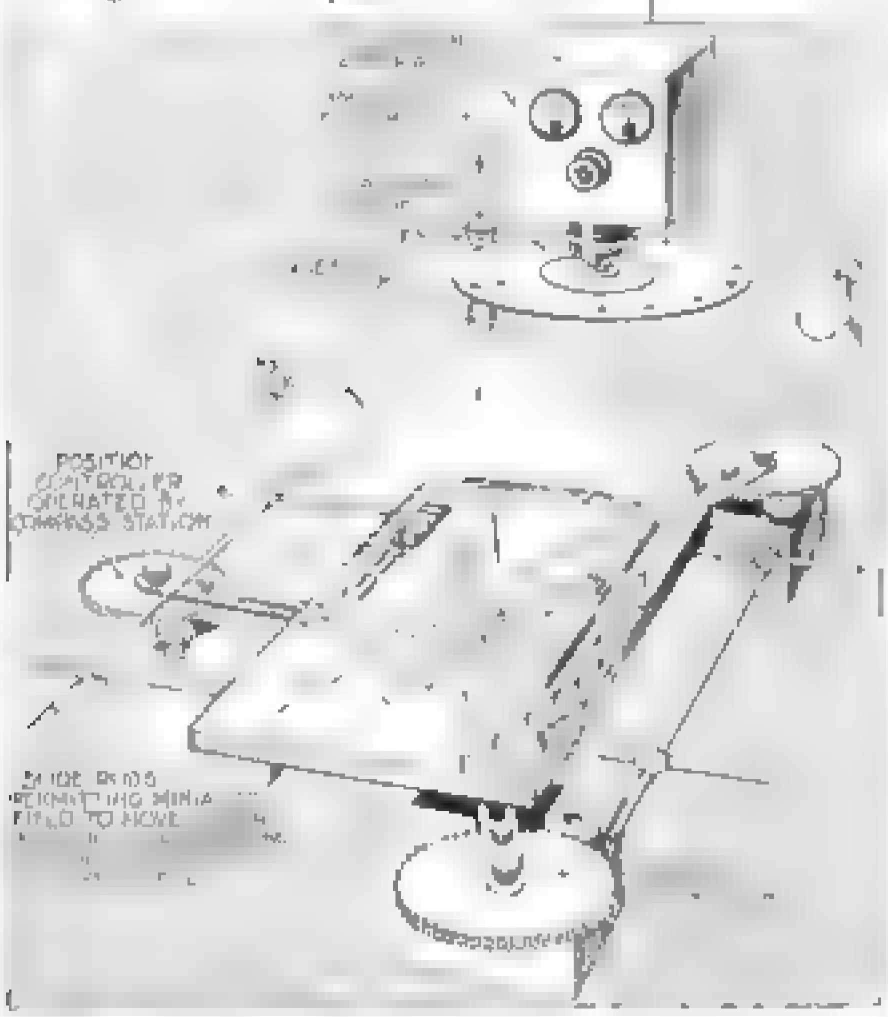


Diagram of miniature field, a television image of which is sent to plane in fog and is seen by pilot on screen to guide his landing

NOW, Alexanderson's improvement involves the light source and the method of controlling the light in projecting the television image. Instead of the pinkly glowing neon tube, Doctor Alexanderson used a powerful arc lamp, which supplied a steady and very strong light. He was enabled to do this by the use of a remarkable new light valve, or light shutter device, operating at enormous speed. This valve, known as the "Karolus cell," was developed by Doctor Alexanderson from an invention by Dr. August Karolus, of Leipzig, Germany.

By means of the Karolus valve, Doctor Alexanderson interrupted the flow of light from the arc through the holes in the scanning disk in the receiving set on the stage. The light valve was, in turn, controlled by the received television impulses. The Karolus cell, which contains nitrobenzol, was placed between two prisms, which polarized the light so that it vibrated in one plane only. This was necessary because the new light valve works only on polarized light.

The original Karolus cell was delicate and extremely short lived. Just how Doctor Alexanderson has succeeded in perfecting the valve to the point where it will stand continuous operation under the strain of a high intensity light such as the arc produces, remains his secret.

The new Hammond invention, which is of great interest to aviators, also makes use of the Alexanderson development of the Karolus light valve. With this development he has combined a method used in the Navy to duplicate, at a distance, the position of the loop used to take radio compass bearings.

When Hammond's invention is perfected, the aviator landing in fog or darkness will see before him, just below his regular instrument board, a screen on which will appear a bright image showing every detail of the landing field. Hangars, runway, and the obstructions to aerial navigation at the edges of the field will appear. A round black spot also will show on the screen and this spot will represent the exact position of the airplane over the field.

AS HE sails through the air the spot will move across the tiny map in duplication of his own motion. If he sees the spot representing his airplane heading for some obstruction on the field, he has only to correct his controls, change his course, and the black spot will immediately show by its motion on the map what his change in course has accomplished. At the corner of the map will appear figures indicating wind velocity and the map itself will show the direction of the wind.

No matter how thick the fog or how dark the night, the aviator's map will be as brightly lighted as the field itself would be on a clear sunny day.

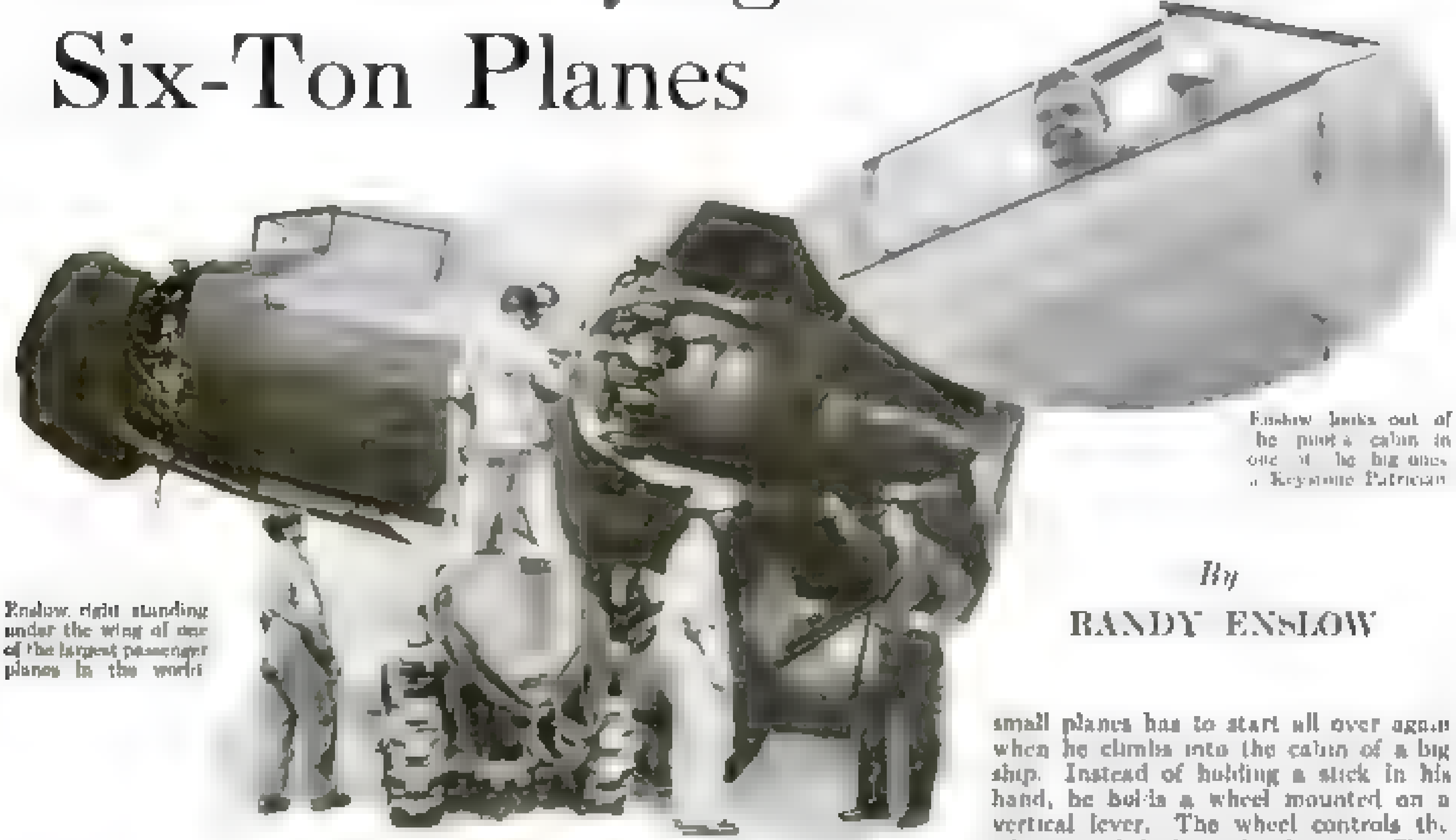
THE method by which this startling result is accomplished is, when analyzed, relatively simple. On the plane there will be a small radio transmitter which will send out a continuous stream of radio waves. These radio waves will be picked up by three radio compass stations equally spaced around the outside edge of the field. At one side of the field, out of the way, will be a television transmitting station, and in this station will be located the unique apparatus which makes the whole invention possible. A conventional type of television transmitter will be set with the lenses pointed straight down. Under this television scanning unit will be a miniature reproduction of the entire field. Every detail of the field and surrounding obstructions will be reproduced in small size to exact scale.

Strong lights will be centered on this miniature flying field. The model field will be mounted in such a way that it can be moved in any direction under the "eye" of the television transmitter by means of three position controllers, each one automatically operated by the corresponding compass station.

The exact means by which this will be accomplished has not yet been revealed by the inventor, but some such scheme as that shown in the accompanying illustration probably will be used. Slotted arms duplicating the actual radio bearing will move the model flying field. Three arms will be necessary because that number of bearings are needed to locate a point.

The spot representing the plane in the television image of the flying field probably will be a tiny disk set at the focal point of the lens (Continued on page 110)

Thrills of Flying Six-Ton Planes



Enslow looks out of the pilot's cabin in one of the big ones, a Keystone Patrician

Enslow, right, standing under the wing of one of the largest passenger planes in the world

By

RANDY ENSLOW

Famous Flyer Tells How It Feels to Pilot Metal Giants of the Air

IT IS queer about big planes. They look like elephants and they fly like swallows. It is only when you take off and land that you realize how large they really are. A few years ago, I thought the wings of my seventy-four-foot-span Ford were a mile long when I sat down after dark in a tree-lined cotton patch on a forced landing.

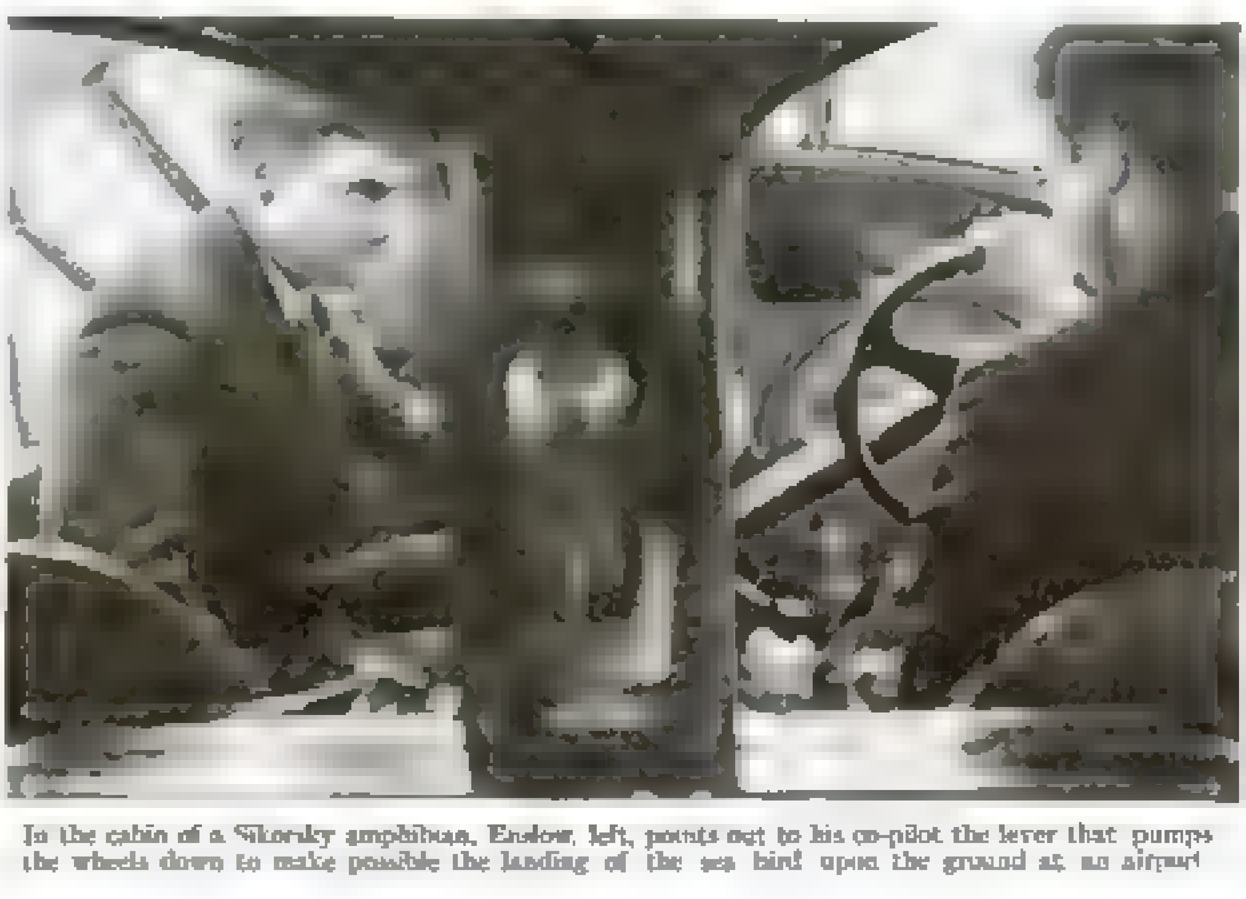
I was flying thirteen passengers home from an Elks' convention in Florida. All afternoon the big Ford plowed northward bucking strong head winds. By the time we reached Flomaton, Alabama, the gas was running low. Dusk had fallen. A ground mist hung over the fields. I switched on the landing lights and circled to pick out the biggest field. A Ford sits down at sixty miles an hour and needs room.

The largest field, eight or ten acres, was almost surrounded by trees. But a gap on the down-wind side seemed big enough to let us through. When I pulled back the three throttles, one of the motors was already sputtering. The landing lights made two streaks of yellow across the white field of cotton as the six-ton ship came in at a mile a minute. As it neared the gap, the huge metal wings seemed to expand, the trees to crowd together.

Just when I thought the ship would never get through the gap, it whistled past the dark trees and sat down as smooth as silk. I was heaving a sigh of relief when I almost went through the bottom of the ship. Half the cotton rows were planted in the direction we landed. The other half ran at right angles. We struck the crosswise rows going forty miles an hour and hopped around like Mexican jumping beans until the ship slowed down.

A pilot who has been used to flying small planes has to start all over again when he climbs into the cabin of a big ship. Instead of holding a stick in his hand, he holds a wheel mounted on a vertical lever. The wheel controls the ailerons and the lever the elevators. Turn the wheel to the right, the right wing goes down. Turn it to the left, the left wing goes down. Push wheel and stick forward and the nose of the plane drops. Pull them back and the nose rises. Steering to right and left is accomplished through regular rudder pedals. This is called the "Dep" control system. It gets its name from the early Deperdussin monoplane, the first machine to use it. The wheel gives much greater leverage and makes movement of the huge ailerons considerably easier.

The first big plane I flew was a 1,275-horsepower tri-motored Fokker with a wing spread of seventy-nine feet. "Bill" Stultz, who piloted Amelia Earhart across



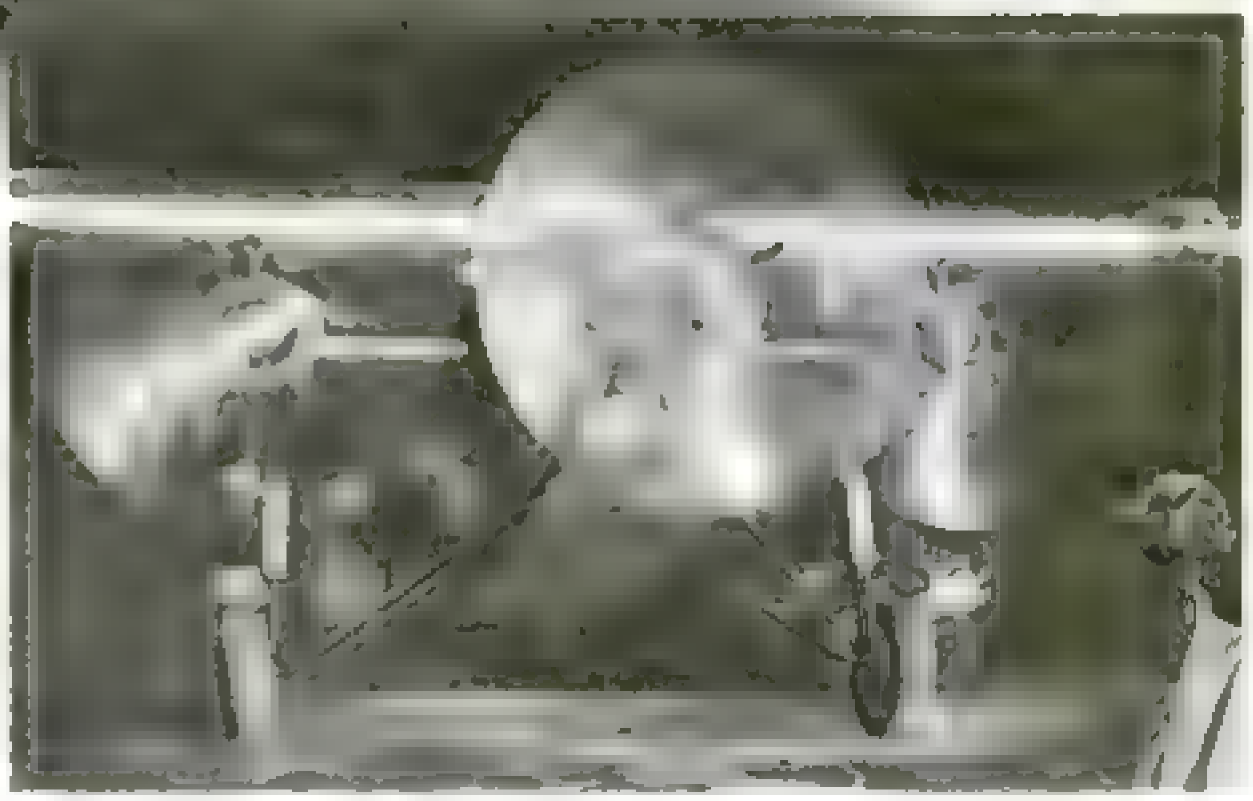
In the cabin of a Sikorsky amphibian, Enslow, left, points out to his co-pilot the lever that pumps the wheels down to make possible the landing of the sea bird upon the ground at an airport

With landing lights piercing the dark [illegible] wing [illegible] night

the Atlantic, brought it up to Rochester, N. Y., in the early part of 19[illegible]. He let me fly it several times. That gave me a taste for big machines.

Since then, I have flown three-motored Fords, other Fokkers, big twin-engined Sikorsky amphibians, and a giant Commodore flying boat with a wing big enough for a small ship to land on. In landing it touched the water at sixty five miles an hour and ran for ten blocks before it came to a stop. The old OX Standard, that Lindbergh and I barnstormed in, could have landed and taken off a dozen times in that distance.

Yet, such monster planes require little more strength to pilot than smaller ships. They are so large they are not upset by small gusts. You do not have to move the controls continually. However, such machines are more sluggish. They are not as easily managed. They can't be whipped around in quick maneuvers. Consequently, when a big, heavy plane gets into trouble, it takes a whole lot longer to get it out.



This remarkable photograph shows a monster tri-motor plane warming up its motors before taking off for a night flight. The three propellers must be tuned in, by ear, to avoid vibration.

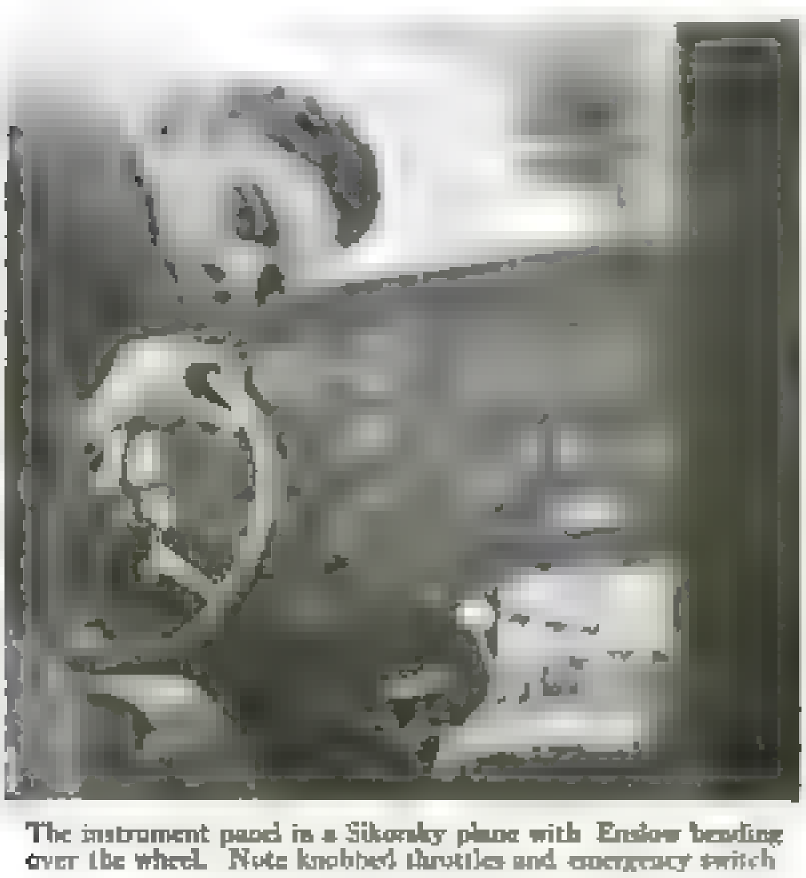
I had a taste of what a big plane in a tail spin is like last summer at Detroit. I had gone out to the Ford factory to get a new twelve-passenger tri-motored job. Before I accepted it, I had to test it. And one of the tests was a tail spin!

With a mechanic and another pilot in the plane, I took off, the three motors howling. We climbed to 5,000 feet over Dearborn. Then I eased back the throttles and pulled up the nose. For a moment the huge plane hung in the sky. Then it whipped over and all of Henry Ford's factories below started streaking around in a circle as the six-ton metal ship made a sheer thousand-foot plunge, spinning like a top. I tried to bring her out of the spin immediately. But she was so big and so heavy that we were below 4,000 feet before I straightened out.

Since then, in testing big ships, I have looped the loop and performed falling leaf stunts in them. In the falling leaf the monster ship swung back and forth across the sky. It was like riding the back of a swaying elephant.

The wildest stunt in a big ship I ever saw was performed by "Bill" Stultz near Roosevelt Field, Long Island. I was looking over a new ship in one of the hangars at the west side of the field. I heard a ship coming down with two big engines wide open. They sounded like a million angry hornets.

When I reached the door, "Bill" was just pulling his three-ton Sikorsky amphibian out of the dive. It shot up and over and down and up and over and down in two loops at more than 100 miles an hour. I expected to see him come down in his final dive riding in a hull without wings. Of course, stunts are never performed in large planes except in testing them. In transport work, they are flown as carefully as possible. Sudden movements of the controls are avoided. Sharp banks are not made. A bank of forty-five degrees is about as sharp as a transport ship is ever tilted in a turn. In coming from turns, the big plane is rolled out of the bank smoothly to avoid strain.



The instrument panel in a Sikorsky plane with Enslow bending over the wheel. Note knobbed throttles and emergency switch

The first time a pilot makes a turn in a big plane he is in (Continued on page 110)

Froth Smothers Biggest Oil Blaze

[illegible] released to wing its way back to its loft [illegible] This is part of a bird's regular military training.

Dove Is Now Night Bird of War

Carrier Pigeons Bred by the Army at Fort Monmouth Fly in Darkness, Proving Old Fanciers Were Wrong

By JOHN E. LODGE

NIGHT flying homing pigeons, something brand-new in the bird world, have been developed by experts of the United States Army Signal Corps at Fort Monmouth, N. J., where most of the carrier pigeons for the Army are bred and trained.

In rearing and teaching these birds, the Government pigeoneers have accomplished a feat which for centuries was considered impossible. From time immemorial, it has been an axiom of pigeon breeding and racing that homers, no matter how fast and faithful, do not fly after nightfall.

World War experience showed Army officials that a night flying species of bird would be vastly superior to the ordinary carrier pigeon both in war and peace time. Immediately following the armistice, the Signal Corps began its breeding experiments. After several years of failure and discouragement, they finally have succeeded.

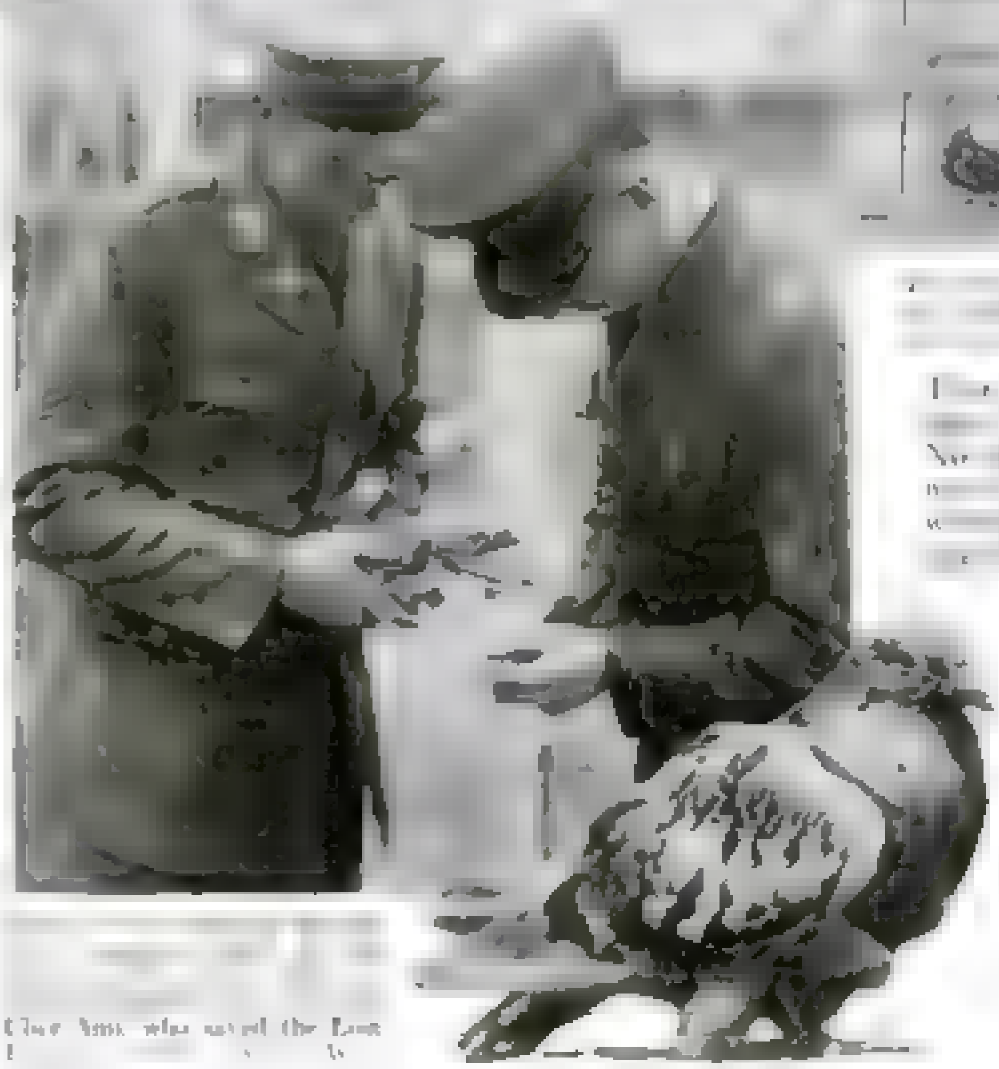
Now there are six pigeons at Fort Monmouth that have been liberated repeatedly thirteen miles from the special night-flyers' loft after dark and have homed consistently. Only one of them, however, has made the flight regularly in the minimum time of twenty minutes.

"Lele," the Signal Corps' night flying record holder. It was bred in the loft at Fort Monmouth and darkness has no terror for it

Many of the night flying birds bred at the Jersey fort in recent months have been shipped to Army posts in Panama, the Philippine Islands, and Hawaii, where they have made much better records. For example, at Honolulu there are six pigeons bred at Fort Monmouth that have consistently flown at night a distance of fourteen miles in eighteen minutes. On occasion, the same birds have flown thirty-five miles in fast time.

It was on a recent visit to the fort that I learned of this interesting new development in pigeon breeding. I had gone to New Jersey to see the country's only real training school for military pigeons and the famous hero birds which still are housed there—the pigeons that saw service with the Signal Corps in France and delivered important messages through the smoke and din of battle, some of them wounded or partly blinded by shrapnel.

Symbolical of peace, the survivors of that gallant flock now make their home in the same loft occupied by a pair of feathered German war prisoners. Twelve years after the armistice, these birds, I found, continue to attract hundreds of visitors to Fort Monmouth. Though the Army



[illegible]

[illegible] Cher Ami, who saved the Lost [illegible]

[illegible] I sought [illegible] on homers came to the [illegible]

[illegible] A bird carrying its message [illegible] would, of course, stand much less of a chance of being recognized and shot.

In the World War both the German and Allied troops were equipped with shotguns for the purpose of killing enemy pigeons. It is even said that the German army carried trained hawks and falcons to destroy them, though how those birds of prey were taught to distinguish between friendly and enemy pigeons has never been explained, so far as I know.

But we are not raising the night flyers for war service only. Think of the good they could do in great disasters, such as floods, cyclones, and earthquakes, when time saved means lives saved. However, it will be quite a while before we shall be able to trust them in such emergencies. Breeding a new race of birds is a slow process. The species must be developed through a few more generations before reliable communication can be had over a distance in excess of five miles.

Three reasons, Ross explained, may be responsible for the superior performance of the night homers at Honolulu. First of all, the atmospheric conditions are believed to be more favorable. Secondly, the island of Oahu, where Honolulu is situated, is small, and the sound of the ocean may help in guiding the birds.

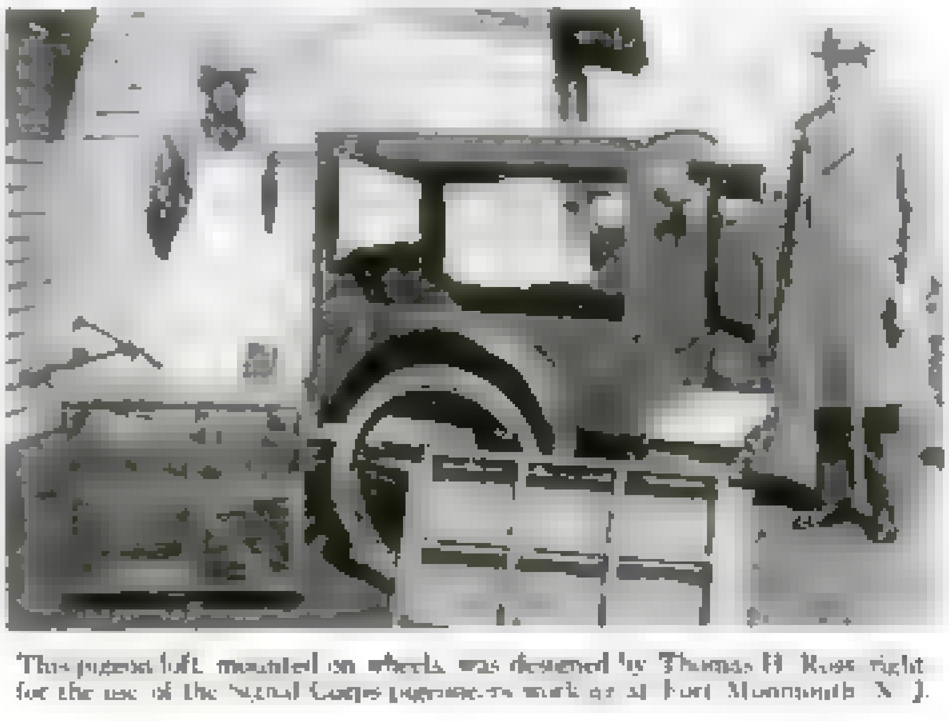
[illegible]

[illegible] began by studying the [illegible] were conducted in which [illegible] offspring were used. In this way a carefully selected strain was isolated for breeding purposes.

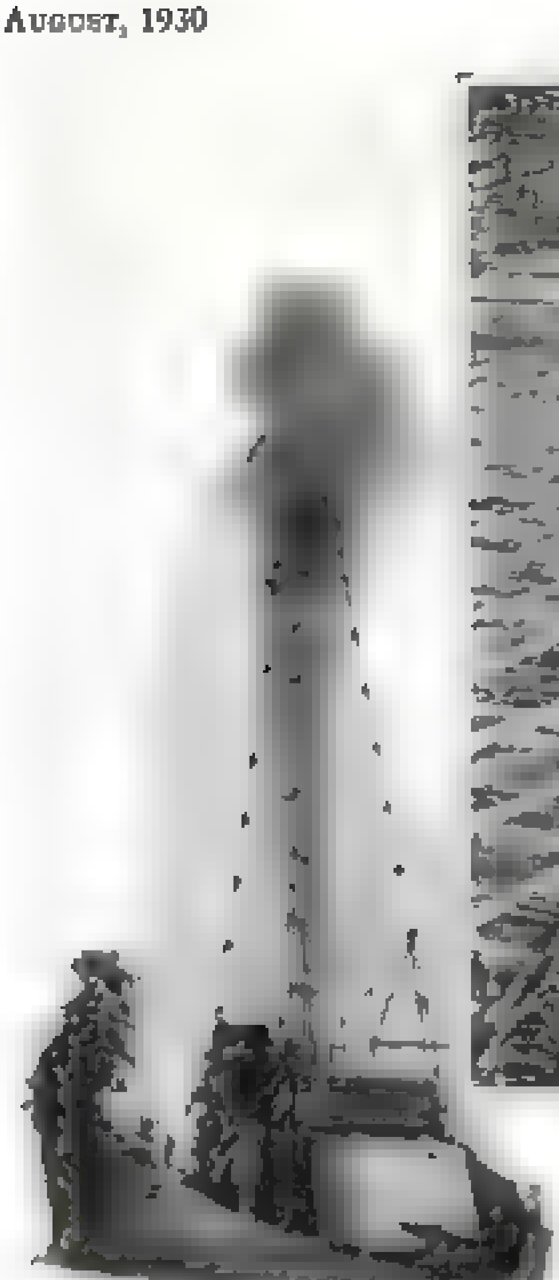
A twilight flying tendency, however, was not the only characteristic considered in the selection of these birds for parent stock. It also was deemed necessary for them to have previously bred one generation of reliable message carrying homing pigeons. The young birds thus obtained possessed the twilight flying propensities and the homing instinct of their parents. Besides, they were sufficiently strong physically to be trained to fly distances up to 100 miles, the minimum required by the Army of each bird that is to become part of its communication system.

As these "squeakers" had to be taught a new set of tricks, it was necessary to give them their physical and mental training at the same time. Thus, their "schooling" starts earlier than that of ordinary homers, which does not begin until the age

(Continued on page 117)



This pigeon loft, mounted on wheels, was designed by Thomas H. Ross (right) for the use of the Signal Corps pigeoneers working at Fort Monmouth, N. J.



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New Pipe Lines Point to Gas Heating Era

By ALDEN P. ARMAGNAC

CHICAGO is going to get natural gas. San Francisco already has it. New York may get it.

This is likely to make radical changes in the daily lives of millions of Americans who live in, or near, those cities. For natural gas is cheap gas.

Natural gas comes from wells where Nature put it and is free for the finding. It is better than manufactured gas because it has twice as much heat in it. It is, therefore, far cheaper to use, even when the price, by the cubic foot, is the same for each.

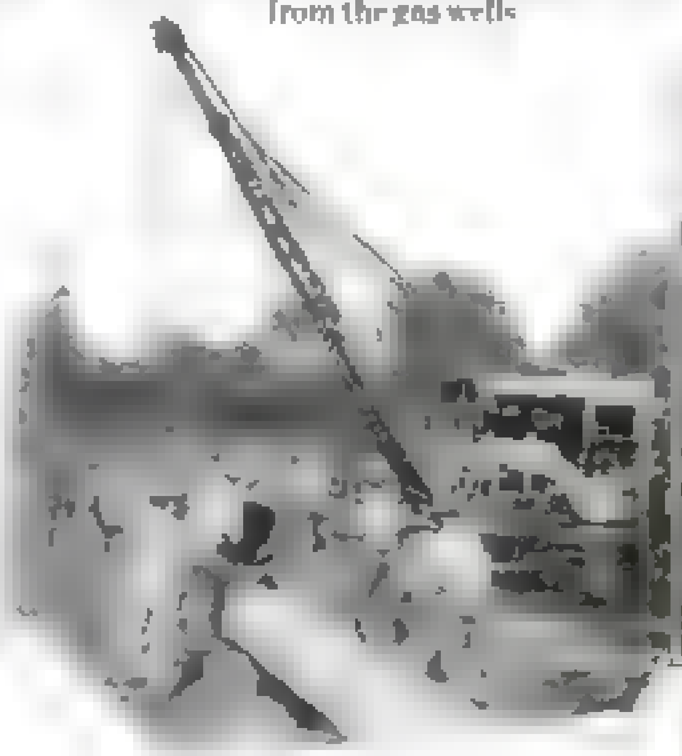
Most people use gas to cook or to warm a room with gas logs or heater. Also they may have a gas refrigerator. But now, with cheap natural gas, such "rich man's luxuries" as heating a whole house with gas, all winter, begin to look practical. Imagine, for example, the basement of your home turned into a beautiful living room. At one end is a polished, glistening boiler. There are no coal bins. A small pipe near the floor supplies gas, automatically, whenever a thermostat calls for heat. There is no shoveling, ashes, smoke, or soot, no worrying about fuel delivery, for the fuel comes underground through the city pipes.

No scarcity of natural gas has delayed the realization of such a dream. Fifty-two great natural gas fields, and many smaller ones, dot the country. The greatest of them in area is the Appalachian field of Pennsylvania, West Virginia, Ohio, and Kentucky from which flaming jets of natural gas, burning unchecked from open pipes, once lighted the night streets of Pittsburgh, Pa. Texas, Indiana, Louisiana and California have important fields. Only within the last two or three years have engineers set out to bring the product of these fields to the big cities.

Now pipe lines, hundreds of miles long, have been laid. "High pressure transmission lines," the engineer calls these hollow worms of steel that connect the gas field and metropolis. Eighty thousand miles of them spread fanwise, today, from the gas wells.

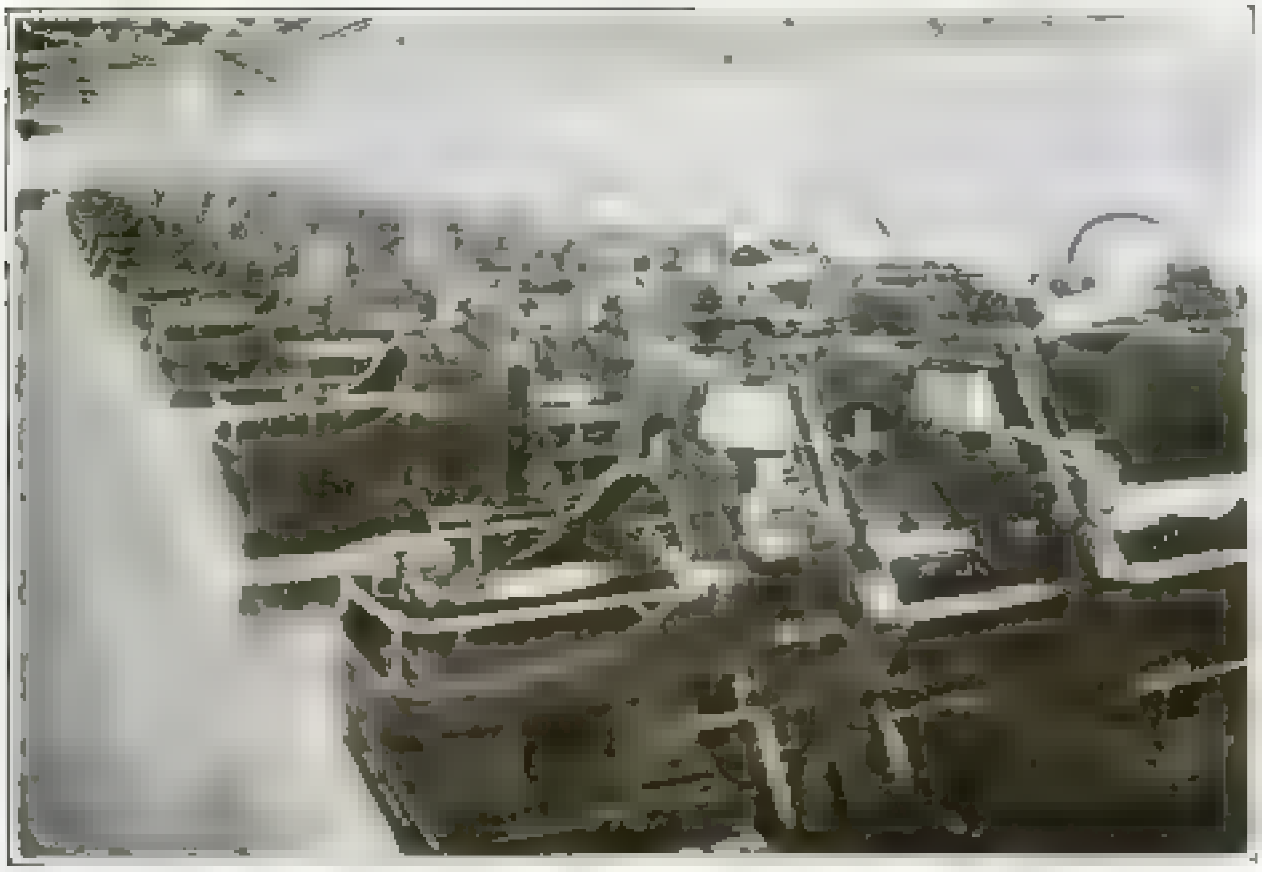
First of the really long-distance lines was the 375-mile pipe that brought natural gas from Amarillo, Texas, to Denver, Colo. Constructed at the record rate of almost two miles a day (P S M , Feb. 29, p. 75), it was completed in 193 days. Other great lines followed. One linked Kansas City, Mo., with the same Texas Panhandle field. Another shot northward from the Monroe field of Louisiana 431 miles to St. Louis, Mo.

A great natural gas field discovered in Kettleman Hills, Calif., made it possible



Kent, Moore and Jenks

When a [illegible] it splits into several [illegible] At left, joining two pipe sections [illegible] 461-mile line from Louisiana fields to Atlanta, Ga.



High pressure forces the gas through the hundreds of miles of underground pipes. This view shows the largest gas compression station in the world. It is part of the Louisiana system at Sterlington, La.

to supply natural gas to San Francisco, 190 miles away. Last year the first line was completed and natural gas was turned into the mains. As this is written, a second line from the same field is nearing completion.

This year saw the opening of the longest pipe line for natural gas in the world. Leaping the Mississippi and sixteen other rivers, the twenty-two-inch pipe, which starts at Monroe, La., crosses Mississippi and Alabama and ends in Atlanta, Ga.—a distance of 461 miles.

Now work is under way on a $100,000,000 pipe line that will transport natural gas from the Panhandle field of Texas straight to Chicago—a distance of more than 800 miles. Its three-foot pipes will be monsters of their kind. Extensions will be built west to Minneapolis and St. Paul, Minn., together with other connections to existing gas systems in the East.

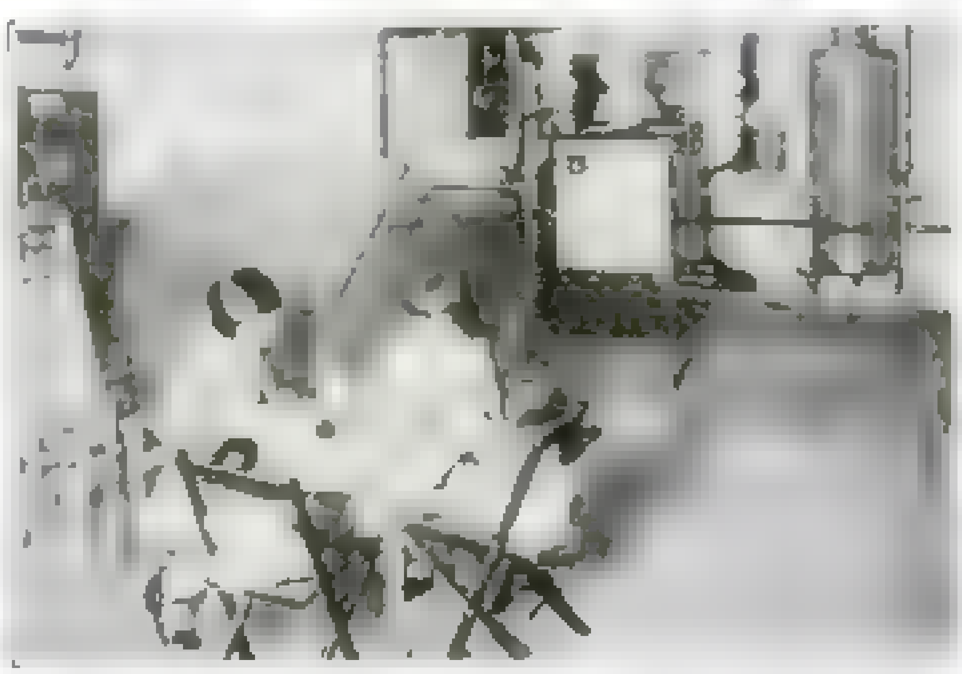
These eastern gas lines, together with oil pipe lines which might readily be converted to gas, already approach within a few miles of New York City. In the very near future, competent observers predict, they will be extended, and New York for the first time will burn natural gas.

The high pressure at which engineers have learned to confine and pump the gas in pipes makes these lines possible. In many fields, the natural or "rock" pressure of the gas as it issues from the well is not sufficient to force it through the long pipes. So lines from the individual wells converge at the gas field in a compressor station. Here powerful pumps squeeze the gas to a pressure of from 200 to 400 pounds to the square inch and start it on its trip through the pipe line. Before it reaches its destination it may pass through several compressor stations, and mingle with gas piped in from other fields.

So tightly is the gas squeezed into the line that a twenty-two-inch pipe becomes a real reservoir. If a break should occur, the line could be shut down for repairs and those in the distant city would be unaware of any trouble. There would be enough gas in the pipe to supply the city for two or three days, at least. That is why big storage tanks above ground are not needed by this natural gas system.

The size of a line-laying job is suggested by the fact that pipe and other materials for the new Louisiana-to-Georgia pipe line would have filled 5,000 freight cars. Such a project can afford no mistakes. It starts with a careful survey of the route. Airplanes helped survey this line, the mosaic maps they made being used in selecting a route through difficult sections of the country.

When right-of-way men have bought the necessary land, the real work is ready to start. Pipe is unloaded from railway cars and strung out along the route. Speedy machines, one type of which can dig a mile of trench five feet deep and twenty-six inches wide in a day, scoop out a ditch in which to bury the pipe.



Courtesy American Radiator Co.

With the swift spread of gas lines, many city homes may soon contain rooms like this. It shows a basement as a playroom, with gas boiler in background

Meanwhile the pipe is assembled beside the ditch. This job calls for experts. While a pipe crane dangles a new section, a skilled workman, a "pipe stabber," guides it home into the last coupling on the line already laid. A slip of his hand would allow the pipe to be dented and spoiled. Other experts apply the bituminous coating that protects the pipe from corrosion underground. The men who laid the southern pipe line knew just how much protection was necessary because they had made a chemical survey of the types of soil all along the route.

Not even when it is joined and buried is the line complete. Starting from the gas field, crews march along it and at regular intervals dig it up again. They cut it and blow it out to remove rust, scale, and any possible obstruction by turning high pressure gas into it. Then

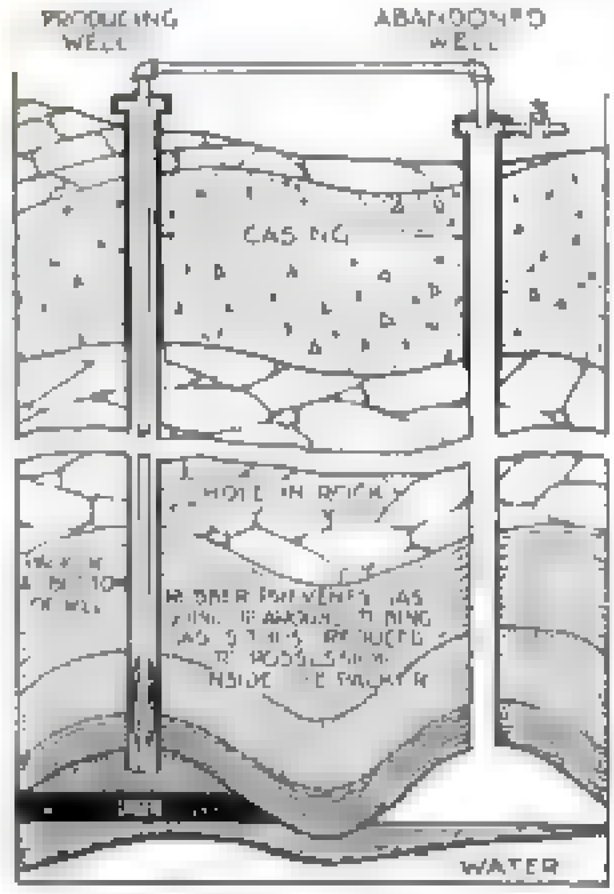


Diagram showing how it is possible to use abandoned well as reservoir in which to store gas

a valve is inserted to shut off the gas supply when future repairs may be needed.

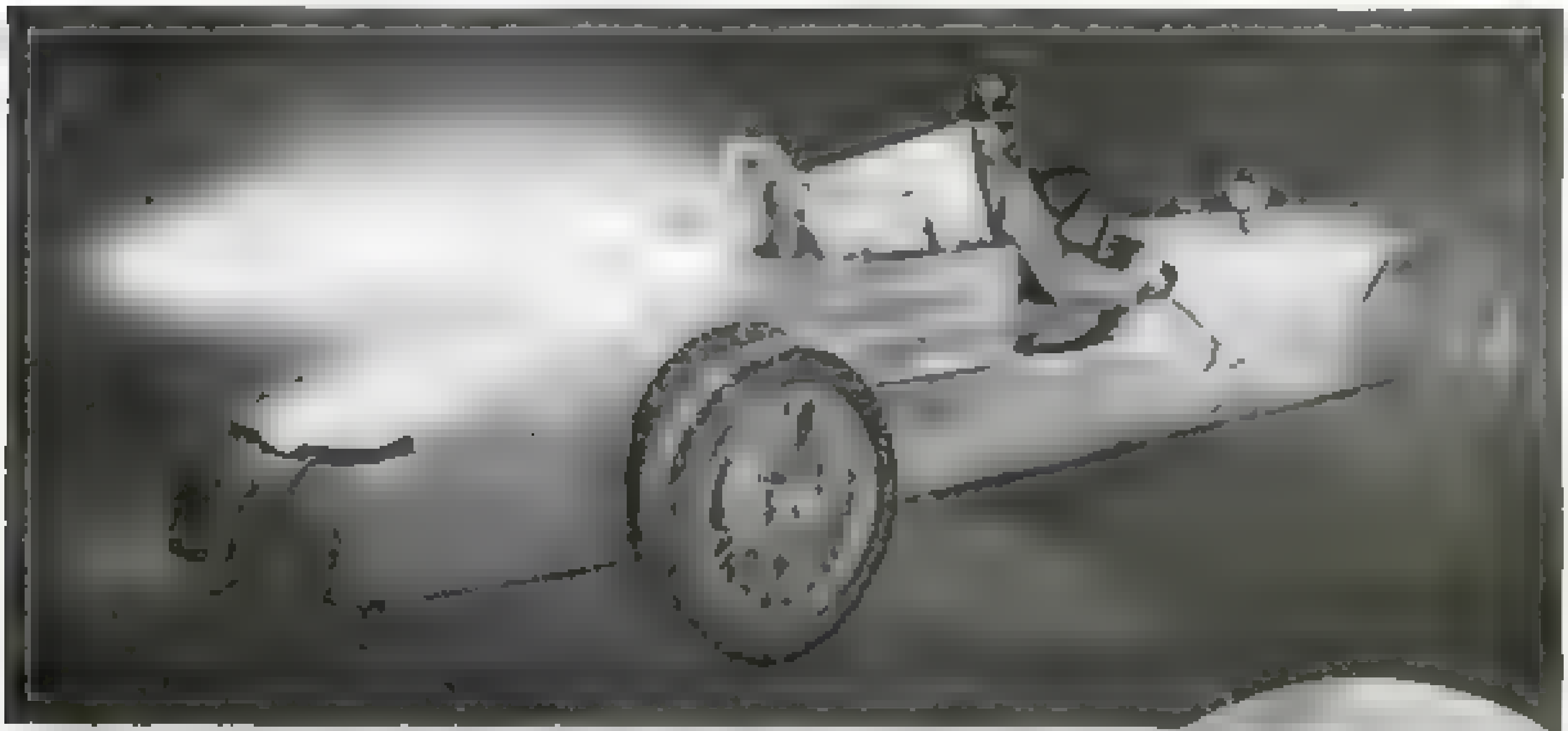
Almost anything may come out of the pipe when it is blown—rabbits, monkey wrenches, articles of clothing, lunch boxes. While a gas line is being laid, its open end may hold a workman's overalls or his lunch and occasionally a section is added before he removes them. At night the open pipe attracts small animals. Usually they flee with the arrival of the morning gang, but sometimes they dash far into the pipe instead, to come hurtling out when high pressure is applied.

Line walkers, like patrolmen on a beat, regularly inspect sections of the pipe. Each carries a large implement resembling a crowbar, which he thrusts into the earth every now and then. He puts his nose to the hole thus made and sniffs for escaping gas. There are visible signs, too, when all is not well with a gas line. A patch of vegetation

Continued on page 117

NEW IDEAS AND INVENTIONS

On this and succeeding pages are described the latest achievements of inventors and novel applications of scientific progress



A blast furnace and refrigerator in one: this liquid air car, with Max Valier at the wheel, traveled ninety miles an hour in its first test. On a later trial, an explosion killed Valier

LIQUID OXYGEN RUNS AMAZING AUTO

A DARING attempt to drive an automobile with the terrific power of fuels like benzine burning in liquid oxygen succeeded at Berlin the other day. Shortly after, one of its two inventors was killed when he sought to repeat the feat.

Dr. Paul Heylandt, German liquid air expert, and Max Valier, builder of rocket cars, were in search of something more than merely a new kind of automobile. They were looking for a concentrated, lightweight fuel that might drive an airplane at tremendous heights across the Atlantic, or even send a projectile to the moon. Rockets filled with gunpowder had proved impractical because they burned out in a few seconds. So the experimenters' latest choice of fuel was a mixture of a combustible liquid such as benzine with liquid oxygen—supporter of the fiercest sort of combustion.

Blast furnace and refrigerator in one was the remarkable car that they built. One of its two tanks (refilled when necessary from a special "thermos bottle" truck) held oxygen chilled to many hundred degrees below zero to keep it a liquid. Another tank held the fuel—gasoline, benzine, oil, or methylated spirits. When the driver opened a valve, oxygen and fuel flowed through separate pipes to the "motor," a hollow tube little larger than a ginger ale bottle. Here the gases were ignited, and a flame six feet long shot out of the tube with a deafening roar. Its recoil propelled the car forward with a force estimated at more than 200 horsepower.

An ominous event in the preliminary trial occurred when Valier got too hot a mixture of the gases. Instantly the "motor," of hardest steel, melted away. Valier replaced it, and one night the car was ready for its first test.

On this first attempt, the car circled the Tempelhof airport, near Berlin, seven times at a ninety-mile-an-hour clip. Valier showed that he could slow it, bring it to a stop, and start off again—stunts that were impossible with his previous rocket cars, which had to keep on going until the rockets burned up.

While Valier was preparing the car for a run with oil fuel, something went wrong. Probably fumes of the gases escaped from their separate tanks and mixed, causing an explosion that hurled Valier twenty feet. He died while being rushed, unconscious, to the hospital. Yet the risky experiment proved, Doctor Heylandt said, the scientific possibility of driving vehicles this new way.

In oval, Max Valier in his dangerous automobile ready for the first trial spin. Liquid oxygen and benzine, exploding in the tiny cylinder, drive this machine by the tremendous recoil. In the center illustration the inventors, Dr. Paul Heylandt, left, and Max Valier, watch while their strange car gets its supply of liquid oxygen

STEEL FLOORS MAY LEAD TO HOMES OF STEEL

Floors of steel for private dwellings may become a commonplace, one of these days. They will introduce to Americans the idea of building entire houses of steel, Lee H. Miller, New York engineer, recently told the American Iron and Steel Institute.

Bungalows and mansions, he says, may take advantage of the same kind of flooring that is used in ocean liners and in factories. It need not be unbeautiful; liners, for instance cover their steel floors with cork tile in mosaic patterns. Steel floors are fireproof, may easily be resurfaced with tile, weigh less than present floors and reduce the thickness of building material between the stories of a home Miller points out

Later frames, roofs, and partitions of steel will follow, he predicts. Already all steel houses have been built experimentally in various parts of the country, but with such an introduction they might become standard architectural practice.

NONMELTING ICE GIVES SKATERS LONG SEASON

A nonmelting, durable, artificial ice that should be a benefactor of hockey players and fancy skaters has been brought to the United States from Germany. Called "opal ice" it is a secret composition made by adding hot water to certain chemicals. It was invented by Max Heinrich Gurth, a German engineer

The first consignment of the novel weather-proof ice to this country arrived in the form of a miniature skating rink cut into squares measuring six by six feet The rink was large enough to hold four or five skaters and was used for purposes of demonstration in New York City. The new ice is not cold to the touch and is of no value in a refrigerator.

Above, a cake of the nonmelting hot ice made in Germany Below, making a year-round skating rink out of the artificial ice Note that hot water is one of the chief constituents of the strange material.

RED WINDOWS STOP FLIES

If you want to keep house flies out of a room, try fitting the windows with yellow or red panes of glass That is the conclusion of tests made by a British glass company, at the suggestion of Prof. Robert Newstead, of Liverpool University, England

This concern built a set of experimental rooms, each having free access to the next. One room had windows of white glass; others used glass of blue, green, yellow, and red tints.

Flies immediately gathered in the room with white windows, straying impartially into the rooms of blue and green light. But most of them scrupulously avoided the rooms where the windows admitted only yellow or red light. One explanation suggested was that the latter tints resembled sunset, and made the insects fly to a nighttime hiding place.

ELECTRIC VIOLIN PLAYS WITHOUT SOUND BOX

An "electric violin" has just appeared in Paris. Played by hand in the usual way, it has no sound box. Instead the tone of the strings is electrically amplified and made audible through a loudspeaker. The result, according to the inventor Ivan Makhonin, is a pure tone especially pleasing against a background of other instruments

All stringed instruments employ some mechanical device to amplify the sound of the vibrating strings—such as a taut drumlike head, or a hollow sound chamber as in a mandolin. The electric violin uses an "electric pick-up," much like that used to reproduce phonograph records through radio and loudspeaker

METER MEASURES LIGHT FOR PHOTOGRAPHER

Correct exposure for amateur movie-making is guaranteed by a new type of "exposure meter" that measures exactly how bright the light is in which the picture is to be made. It is so sensitive that through its use a photographer may select one exposure to bring out the shadows of a man's face or another for the highlights, depending on the effect he desires.

The ingenious meter enables the user to match the brightness of portrait or landscape against that of a flashlight bulb within the case of the instrument. In a semitransparent mirror, the operator sees the image of the flashlight bulb's bright filament directly on top of the scene he is going to photograph. He turns a ring on the instrument, which brightens or dims the filament of the lamp until it exactly matches the brightness of the scene. Then a numbered scale tells him the correct exposure

Since the device is especially designed for use with motion picture cameras, in which the shutter speed is constant, the exposure is varied by selecting the proper size of stop or lens opening, which the meter indicates.

Previous types of exposure meters depended on the darkening of an exposed strip of sensitive photographic paper, or simply on the arbitrary use of scales based on type of subject, time of day, and season of the year. The new type, the manufacturer declares, is the first with which the operator can sight on one specific part of the scene that he wants to photograph instead of measuring simply the general illumination

Current for the lamp is furnished by a standard flashlight battery, which may easily be replaced. A push button turns on the lamp for use.

GAGE GUARDS AGAINST MANHOLE EXPLOSIONS

So that manhole covers in city streets will not be blown skyward by explosions beneath them, G. W. Jones, explosive chemist of the United States Bureau of Standards, has developed a portable gas detector. It reveals in a few seconds whether the air beneath the manhole contains enough leaking gas to make it dangerously near the explosive point.

The operator drops a sampling tube through the manhole, and by squeezing and releasing a rubber bulb he draws a sample of the air into a stoutly built metal chamber or "bomb." A touch of an electric switch, and a spark plug fills the chamber with sparks. If the gas is explosive, there is a muffled sound and the swing of a needle on a pressure gage is a telltale indicator of the explosion.

Should the sample fail to explode, a small, measured quantity of propane, a mildly explosive gas, is added from a tank and the test repeated. An explosion then indicates that the original sample was at least seventy-five percent explosive. If two additions of propane are needed, it was fifty percent explosive. By additional "doses" lesser amounts of explosive mixture are measured.

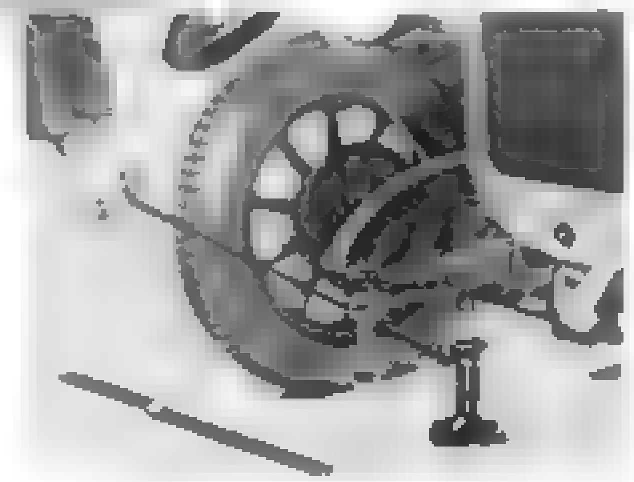
MACHINE WRITES AD IN CLEAR WATER

When a man recently walked down a street in Barcelona, Spain, pushing a machine that left behind it a printed strip of advertising civic authorities were aroused. What right did he have to paint advertisements on the city streets? Inspection showed they need not worry. The ads were "painted" on the sidewalk with clear water by the novel device.

METAL RAMS AID SEARCH FOR PREHISTORIC RELICS

Metal rams, such as workmen use to tamp paving stones in place, are now used to find excavations made by prehistoric people. The method was developed by E. Cecil Curwen, British archeologist.

Walled camps surrounded by ditches were left by primitive tribes in many places in England. Long ago, they were leveled and the ditches filled. But when Curwen went thumping through the chalky soils of southern England with his ram, he found that an undisturbed piece of ground gave only a dull "thud," while a hollow "thoomp" betrayed the presence of an ancient ditch or burial place hidden beneath the filled in soil.



GUIDE FOR AUTO JACK HELPS TIRE CHANGERS

No need to crawl under a car in order to jack up a wheel, when a set of jack-guides is installed. The guides, metal arms which extend ten to eighteen inches from the axle, are put in place by loosening the spring shackles, which are then retightened.

Instead of placing the jack beneath the axle to lift a wheel and change a tire, the curved head of the special jack is slipped on the end of the guide in the position shown by the skeleton view in the photograph. Then it is shoved home. Bearing on the guide instead of the axle, it easily lifts the wheel. Once lifted, the car cannot slip off the jack, even if on a slope.

MARBLE FAKES EXPOSED BY ULTRA VIOLET RAYS

Marble forgeries, imitations of old masterpieces, may now be detected with the aid of ultra-violet rays. These invisible waves do not pass through glass but when they encounter marble they so affect it as to give it a peculiar phosphorescent tinge, somewhat like that of a glowworm. Old marble, under the scrutiny of the ultra-violet rays, is said to have a decidedly different appearance from recently quarried marble. New sculpture that has been "faked" to resemble a genuine Roman or Greek antique is easily shown up. The methods of marble counterfeiters, some of whom alter the surface of sculpture by covering it with pockmarks, can hardly hope to escape detection by this new investigator.

SEEK WAY TO LESSEN SUMMER SUN'S HEAT

How the sun, nearly 93,000,000 miles away, creates a serious engineering problem for architects was discussed by F. C. Houghten and Carl Gutberlet, of Pittsburgh, before the International Heating and Ventilating Exposition at Philadelphia. The two engineers set themselves the task of computing the amount of heat which a house will absorb from the sun in summer weather. They found that during a day of ordinary brightness in Pittsburgh a piece of black oilcloth of one hundred square feet would receive more than one horsepower of energy from the sun. Under ideal conditions the heat received should be more than ten times this amount (P. S. M., Nov '29, p. 22). The difference probably is accounted for by the shielding effect of the smoke and dust over a big city. At this rate a house that had 8,000 square feet of exterior surface would absorb enough energy from the sun every minute to heat ten gallons of water from the freezing point to seventy-seven degrees.

Advertising made its mark when this roller wrote ads, with ordinary water, on the sidewalks of Barcelona, Spain.

Newer and Easier Ways of Doing Familiar Jobs

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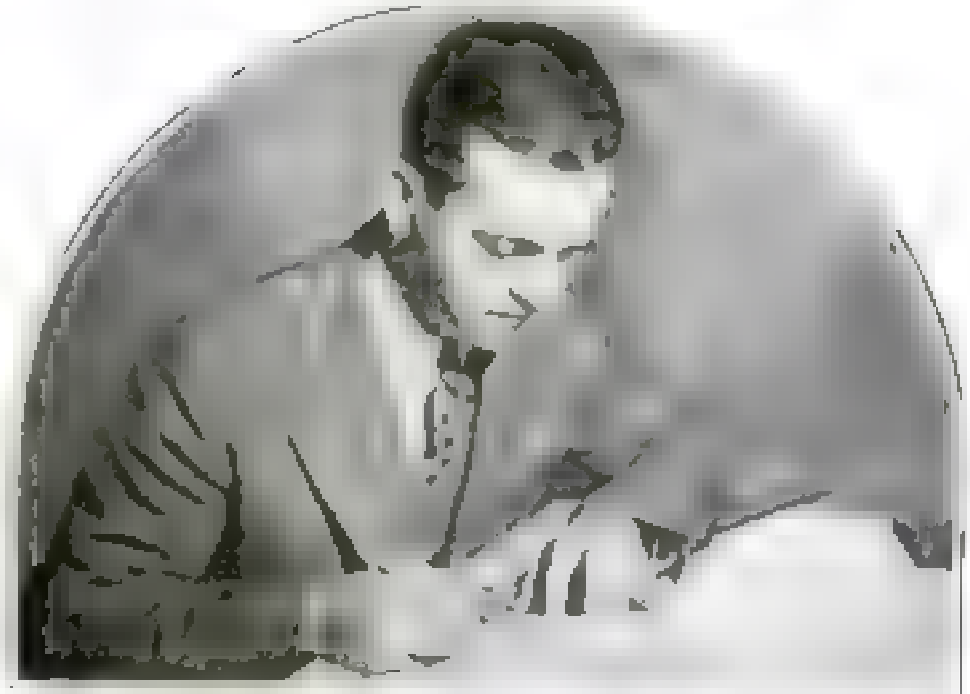
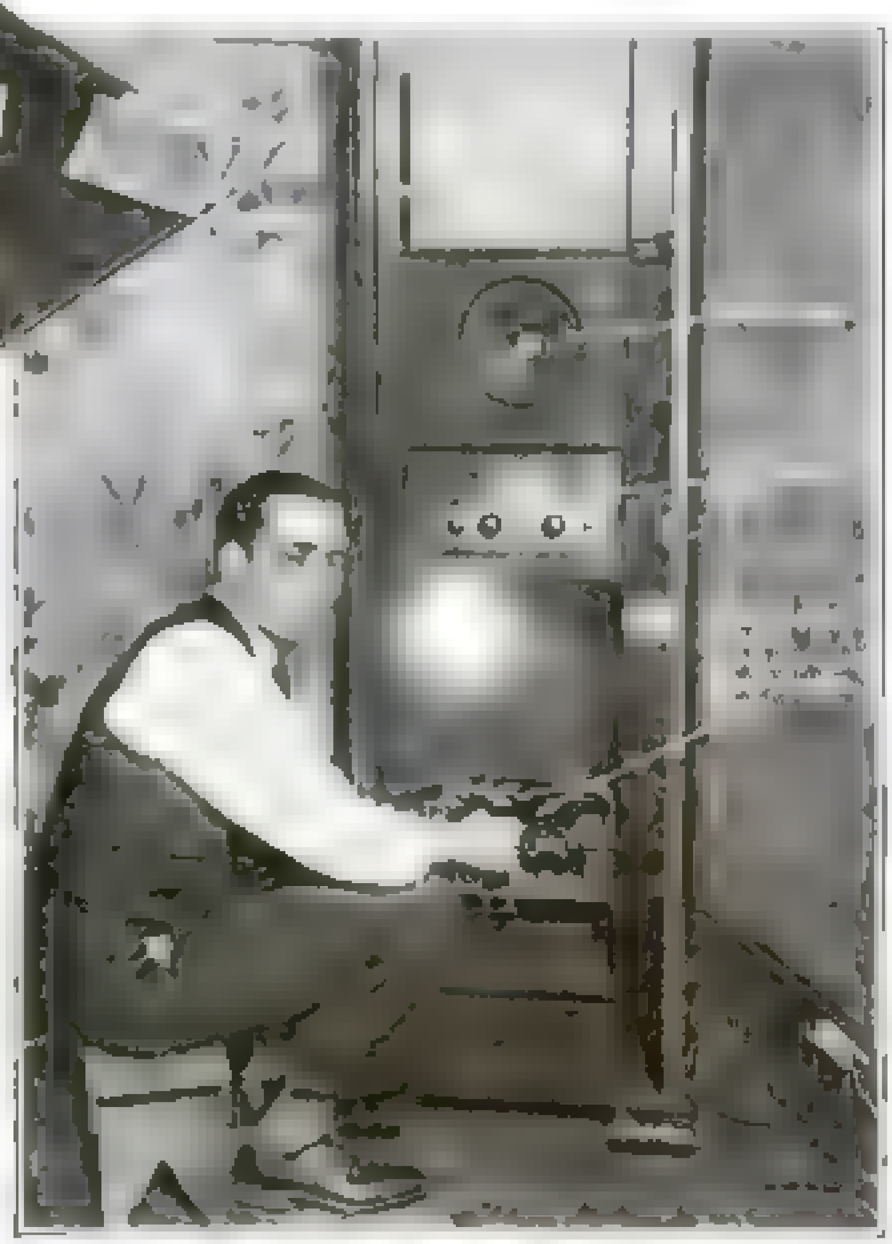
TAKE STAINS AWAY [illegible]



NO EYESTRAIN FOR DRAFTSMEN. A scale magnifier has been designed that is intended to make it possible for engineers and draftsmen to work more rapidly and with greater accuracy. The device, mounted in a … frame … [illegible]



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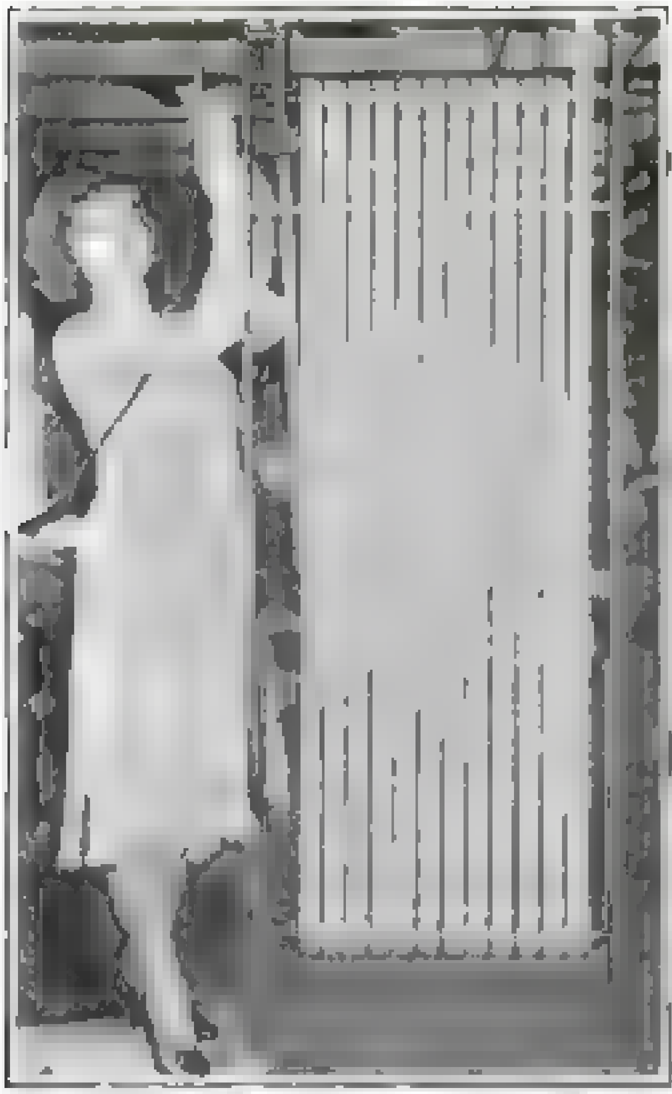
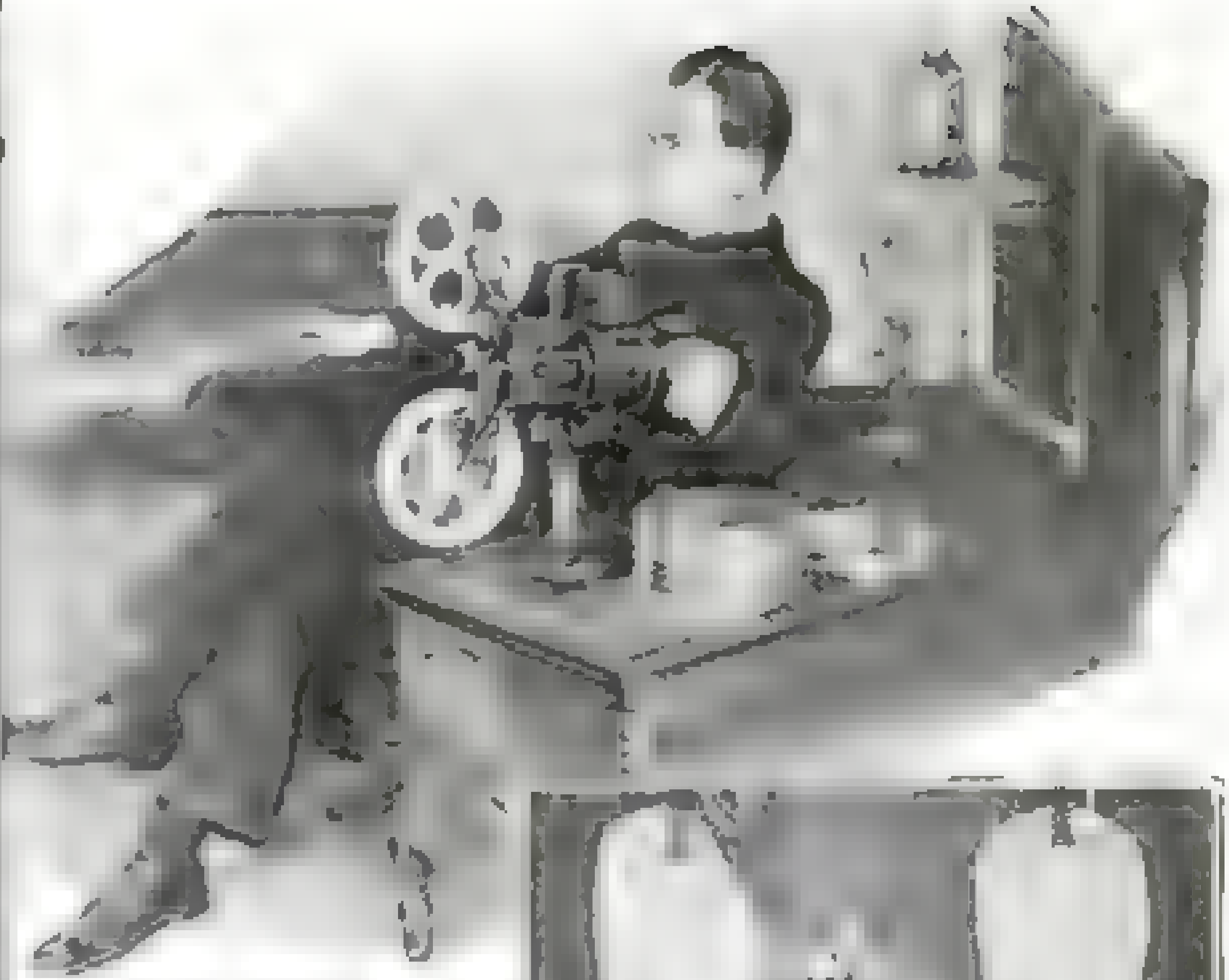
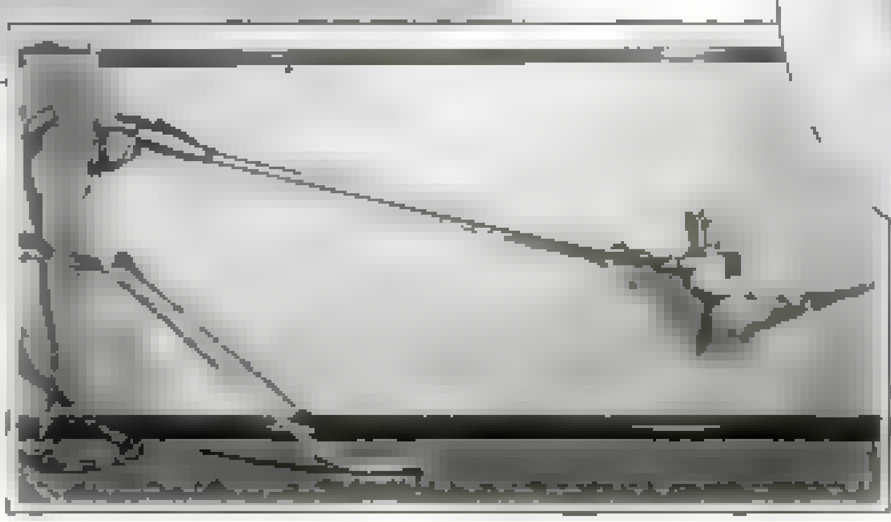
GUN THAT SHOOTS TACKS. [illegible]



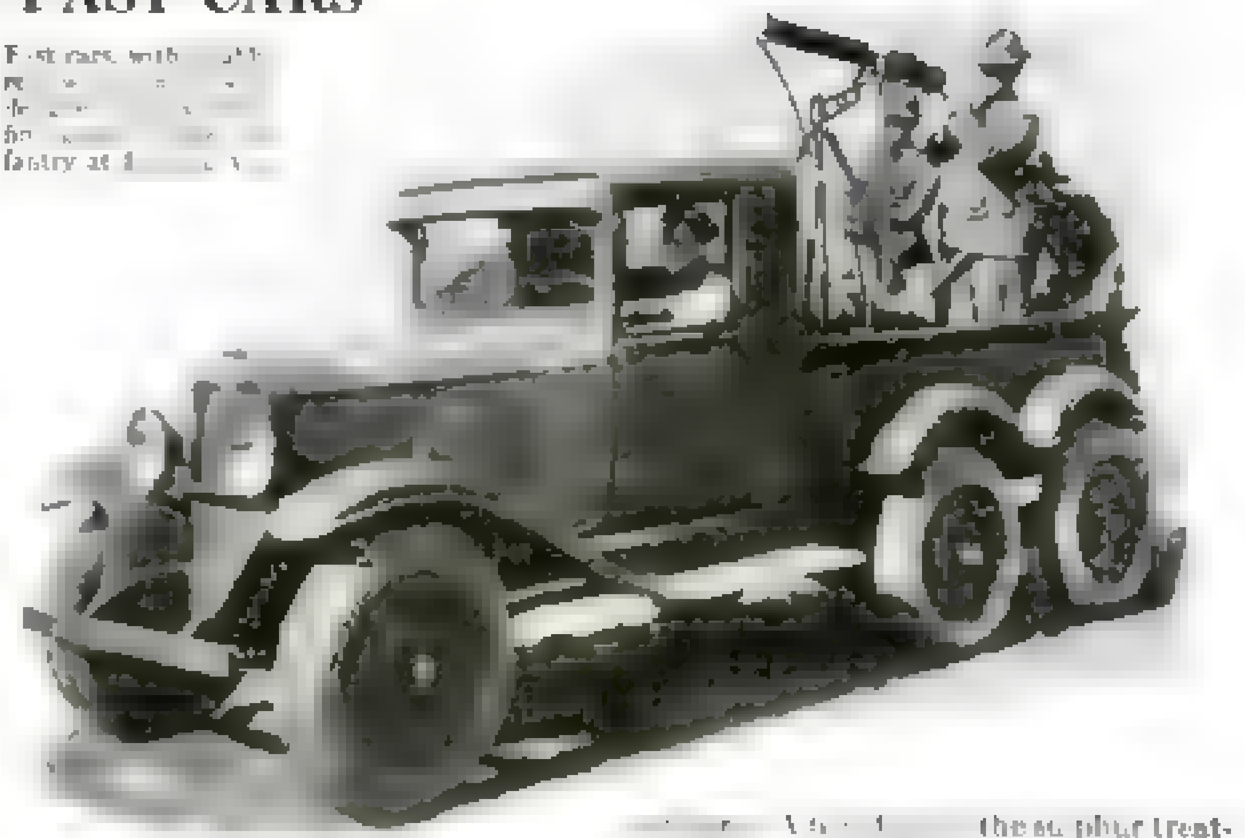




RAPID-FIRE GUNS ON FAST CARS

Flying companies of machine gunners, able to dash from one point to another of a battle front and deliver a decisive blow are presaged by the newest Army equipment—rapid-fire armament mounted on fast cars. It gives the Thirty-Fourth Infantry which is stationed at Leehall, Va., for which it was designed, the first machine gun company of the United States Army to take to wheels

The cars are equipped to travel rough roads, and to cross fields where there are no roads. Tires are extra large to stand unusual punishment. Double wheels in the rear provide firm traction when the going is muddy or slippery



Fast cars with [illegible] fantry at [illegible]

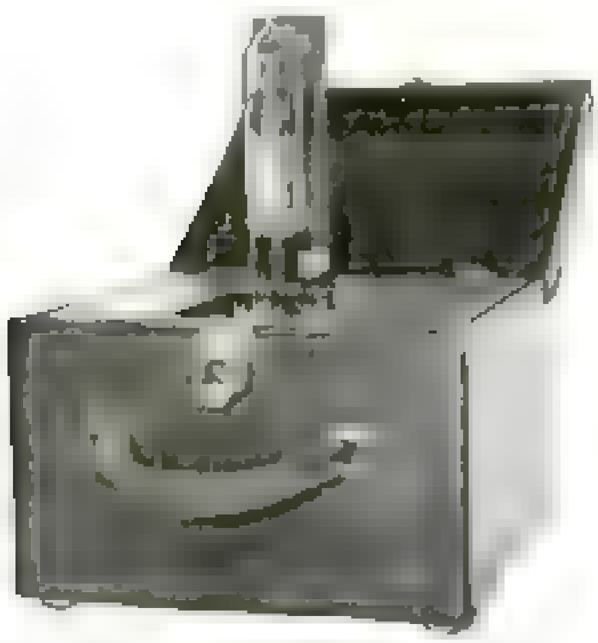
ELECTRIC EYE GUARDS AGAINST SUNBURN

Sensitive only to the particular kind of ultra-violet, or health, rays that have value in curing rickets and producing sun-tan a new "electric eye" is the basis of a machine that automatically tells when a patient has had his daily dose of "sun rays" from a lamp. Thus it avoids the possibility of artificial sunburn from an overdose of the rays.

The electric eye, developed by the Westinghouse Lamp Company, differs from tubes coated with common metals which allow an electric current to pass through when visible light shines upon them. The new device, instead, uses the rare metal uranium

How much ultra-violet radiation the patient has received is shown by counting the intermittent flashes of a light connected to the apparatus, or, in another model, the number of marks made by a pen on a revolving, paper-covered drum The device automatically compensates for any variation or flickering of the light Electric current allowed to pass through the eye in proportion to the intensity of the ultra-violet rays accumulates in an electrical condenser until there is enough to discharge and flash the light or make a mark on the paper

Such a device, officials say, could be used on the beach to warn a bather exactly when he was in danger of sunburn from prolonged exposure to the sun. In a recent demonstration in New York City, it showed how ordinary window glass shuts out ultra-violet rays by ceasing to register at all when a sheet of clear glass was slipped between the "eye" and a quartz mercury-vapor lamp.



Burning with ultra-violet rays is unlikely if this sensitive meter is used in gaging the dosage

PHOTO AND MESSAGE ON PHONOGRAPH POST CARD

Here is a new way to send a greeting to a friend. Phonograph records on post cards have been made before, but now a German inventor has combined the record with a real photograph. The sender has his picture taken, records his voice on top of it, and the result is a personal record ready for the mail. A long message is recorded on several post cards, each one numbered

SULPHUR AIDS AND ENDS GROWTH OF ANIMALS

Growth of body cells throughout the animal kingdom is controlled by sulphur This dramatic statement was made recently by Dr. Frederick S. Hammett, of the research institute of the Lankenau Hospital in Philadelphia, to the American Philosophical Society

Scientists have long sought the key to the mysterious processes of tissue growth and reproduction. Experimenting with more than a million colonies of both plant and animal cells, Doctor Hammett was able to show conclusively that, often, sulphur stimulates cell division during the early stages of a cell's life, and then later acts to deter and eventually to stop the growth of tissue. This last is important as if cells did not halt their growth at certain times, the body of an animal would continue enlarging indefinitely

The discovery already has been put to practical medical use. Sulphur compounds have been employed to aid wound healing. One patient in the Lankenau Hospital, where the medical experiments also were carried on, had been suffering for some time from an ulcer or sore on the heel which the ordinary remedies could [illegible] the sulphur treatment healed the ulcer

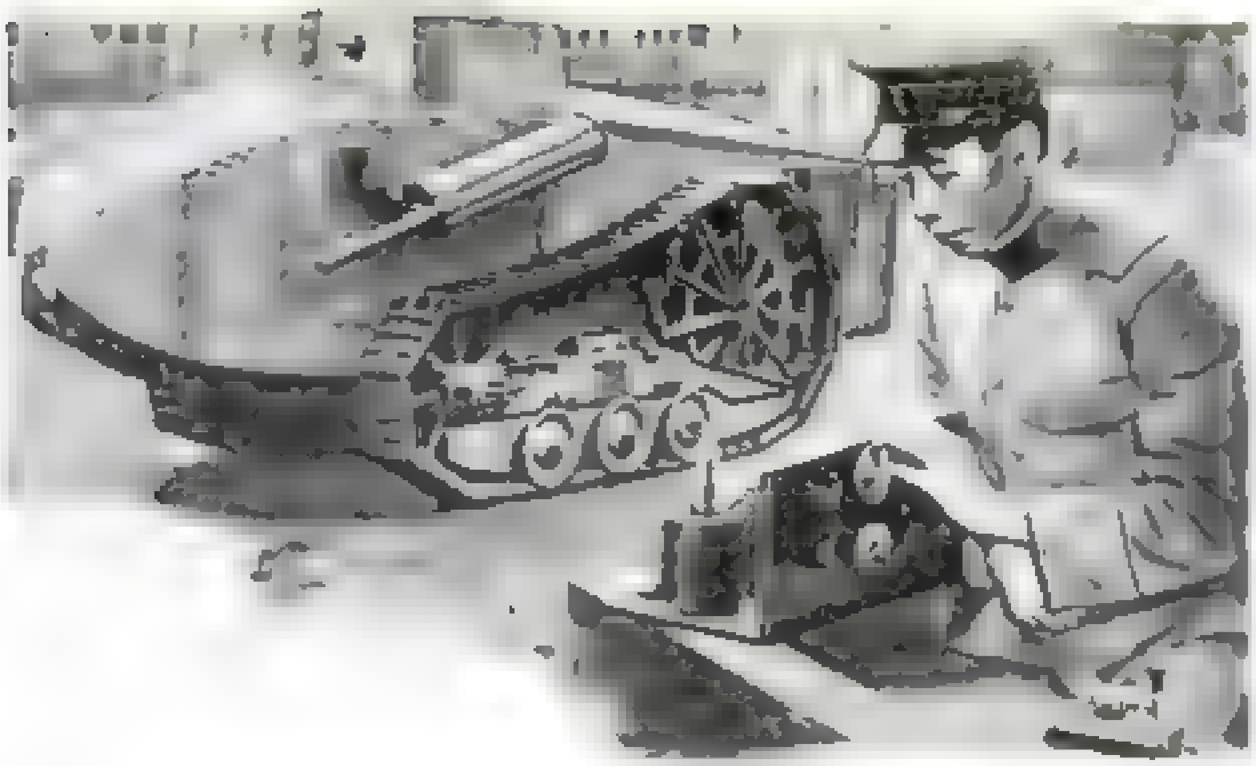
Certain diseases which are due to excessive growth of cells, like cancer, might also respond to some sort of sulphur treatment, Doctor Hammett said. However, Doctor Hammett stated that although the discovery may have some bearing on cancer, it in no way promises a cure

Post card that carries a photograph along with a message that can be played on phonograph

FIND UNEXPLODED BOMBS WITH TELEPHONE DEVICE

When Army men recently decided to dig a seaplane-towing channel at Langley Field, Va., along an area where planes had been conducting bombing practice for many years, they faced a novel hazard The ground had been struck repeatedly by bombs that failed to go off, and these "duds" had buried themselves several feet in the earth.

To find the duds, Dr. Theodore Theodorsen, of the National Advisory Committee for Aeronautics, devised a telephone instrument consisting of a pair of headphones and three large exploring coils of wire mounted on a wooden frame When the coils, connected to an electric generator, were carried over a spot where a metal-shelled bomb rested hidden, a hum in the phones revealed its location.



NO MEN IN RADIO OPERATED TANK

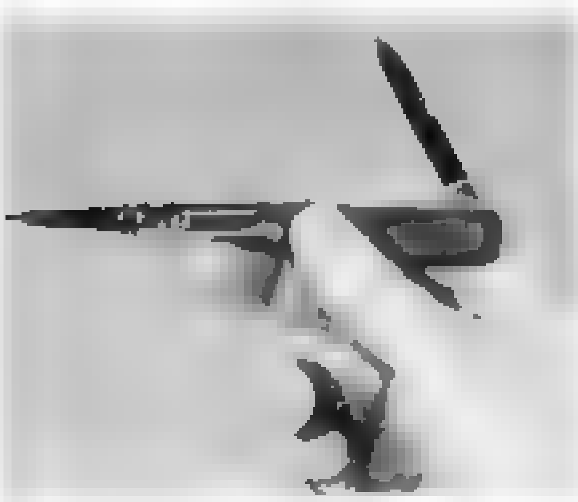
In the future, monster implements of war may be controlled from a distance by the mere turning of a radio dial. A Japanese army officer, Major Nagayama, has invented a means of directing by radio the movements of a tank able to travel at a speed of five miles an hour.

Already wireless control of airplanes has been successfully attempted in England, according to reports. A master radio set took the place of the pilot, acting through tiny compressed air motors which worked the plane's controls.

Such a system of radio control as that of the tank or airplane does not imply the transmission of any appreciable quantity of power by radio. In the tank, for example, the radio impulses serve simply to trip a relay that sets in motion the tank's regular gasoline-driven machinery. Other relays, tuned to proper wave lengths, operate the steering controls.

The amount of power required to operate these relays is as little as that which brings the voices of Amos 'n' Andy into your radio receiver. Just as your own set supplies the power to amplify the faint impulses, so the relays in tank and airplane permit gasoline engines to supply the actual motive power. The transmission of real quantities of power without wires remains at present a dream.

PENCIL AND KNIFE ARE FITTED IN NEW DEVICE



A combination pencil and knife recently has been designed. The flattened top holds a penknife blade, while at the bottom is a pencil of the regulation mechanical type. A penknife is less likely to be lost when it forms part of a device that clips into the pocket.

VACUUM FURNACE BOOSTS OUTPUT OF URANIUM

Uranium, twice as heavy as lead and formerly one of the rarest of metals, is now available to scientists and experimenters at $400 a pound. Discovery of a way to extract the metal in a vacuum furnace made the new process possible, Dr. F. H. Driggs, research chemist of the Westinghouse Lamp and Manufacturing Company, declares. He recently exhibited plates and wires made of the rare metal. They were coated with a brownish color by the burning effect of the oxygen which is in the air, but when scratched they revealed the natural steel gray color of the metal.

SOUNDPROOF CAMERA ROLLS ON WHEELS

A suitcase shaped camera, containing all the apparatus necessary for taking sound pictures, now takes the place of the cumbersome soundproof camera booth formerly used. It rolls about the movie studio on a chassis with large rubber-tired wheels, suggesting those of a primitive type of automobile. A geared mounting on the chassis raises and lowers the camera.

Formerly the "talkies" were filmed from a window in a booth resembling a padded cell, its object being to exclude the faintest noise that would be foreign to the scene. The new camera has a miniature soundproof booth built directly around it, while the operator handles it from the outside. The cushioned wheels are added insurance against noise or vibration.

PREDICTS MOON FLIGHT IN HYDROGEN ROCKET

What would a rocket-propelled ship capable of flying to the moon, look like? A scientific vision of such a craft is outlined by Dr. John Q. Stewart, associate professor of astronomical physics at Princeton University. It would be a massive, hollow globe—the outside studded with rockets to propel it through space, the inside a chamber where men would breathe an artificial atmosphere supplied from tanks. Portable tanks of oxygen would also be carried to enable the passengers to survive an exploring trip upon the airless moon.

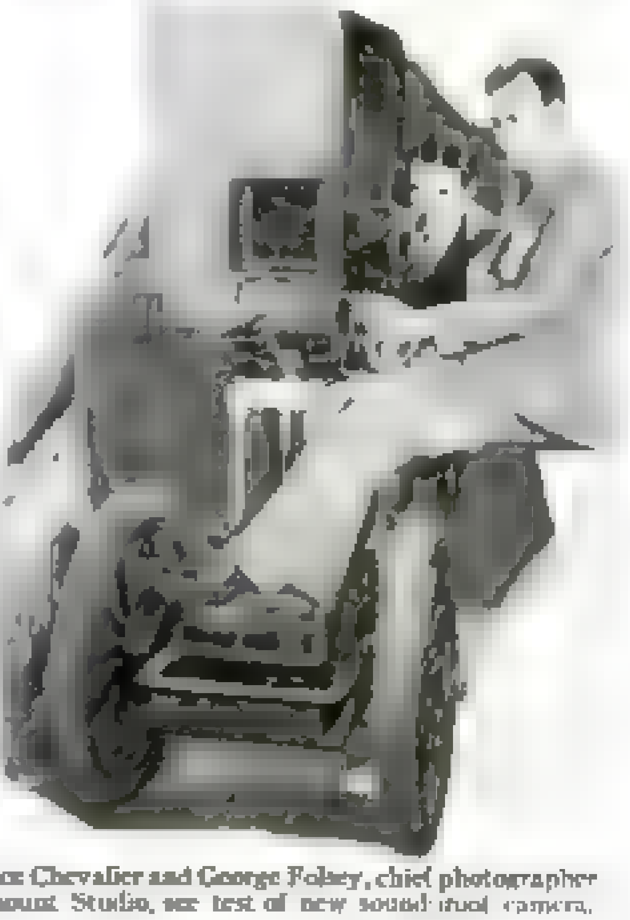
Some fuel still unknown would propel the strange ship; ionized hydrogen, Doctor Stewart suggests, has been made to yield 100 times the energy that is liberated by coal burning in oxygen. This substance is made by breaking up hydrogen gas into electrified particles, but the laboratory-made fuel has never been used to drive a vehicle.

The rocket ship would travel, Doctor Stewart predicts, at the terrific speed of 25,000 miles an hour.

SERUMS FIGHT 20 NEW KINDS OF PNEUMONIA

Twenty new kinds of pneumonia have been discovered in the laboratories of the New York Department of Health, to add to the three varieties already known. The result, according to the director of laboratories, Dr. William H. Park, is that new serums already have been prepared for many kinds of pneumonia which hitherto resisted treatment.

Experiments made by Miss Georgia Cooper, under Doctor Park's direction, revealed that a fourth of all adults and more than half of all children suffering from pneumonia had the disease in an "unknown" form. By patient research the twenty new forms were traced. Once known and isolated, the germs are used to inoculate horses and serums prepared.



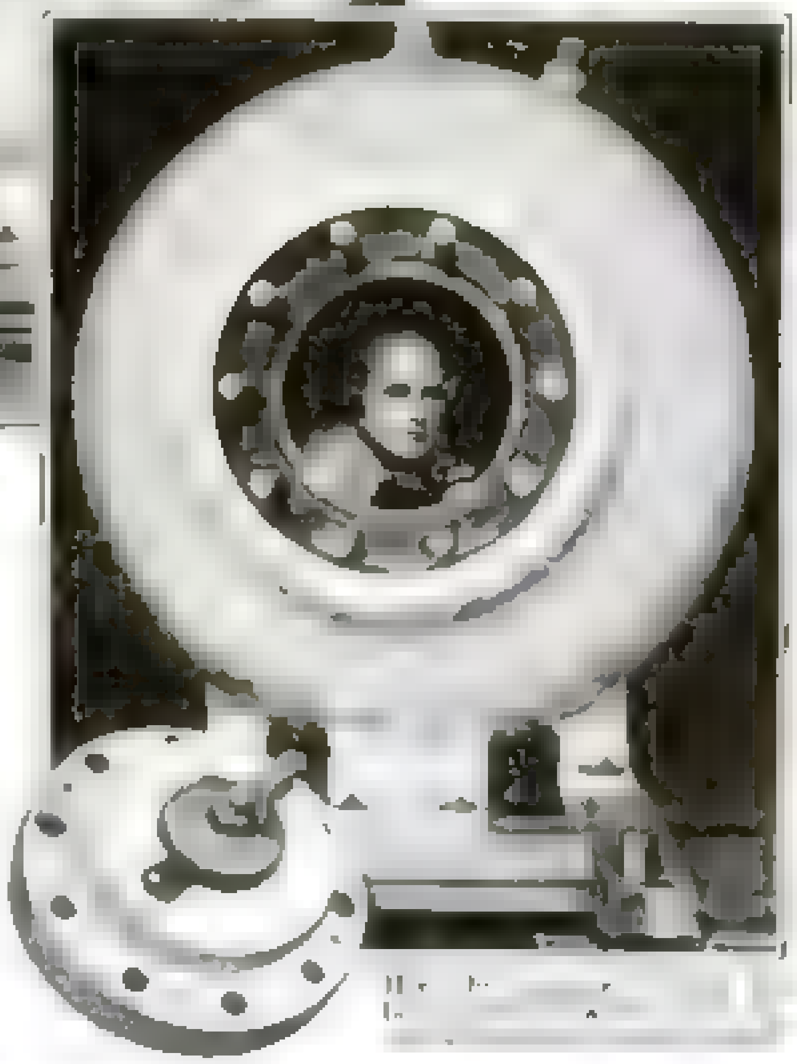
Maurice Chevalier and George Folsey, chief photographer Paramount Studio, see test of new soundproof camera.

1,300 FEET DEEP, IS DIVER'S GOAL

Otis Barton [illegible] sea diving [illegible]

A QUARTER of a mile beneath the sea! That is the goal of William Beebe, noted explorer of the New York Zoological Society. From the portholes of a six-foot sphere of heavy metal, he will observe and photograph deep-sea life off Nonsuch Island in the Atlantic Ocean near Bermuda, where he began studies last year (P. S. M., Mar. '30, p. 49).

The new diving bell invented by Otis Barton defies sea pressure that [illegible] a few hundred feet. [illegible]



[illegible]

FEVER MADE TO ORDER WITH RADIO WAVES

FEVERS made to order are the latest in medicine. A machine that gives a man a "radio bath" and thus furnishes him a fever artificially, was demonstrated recently before the New England [illegible] Therapy Society. It was developed by General Electric Company engineers.

Most fevers are the result of some ailment, and are harmful. But in some diseases, doctors believe, a fever may aid in killing the germs, and in the past various means such as [illegible] hot air baths and injections [illegible] kinds have been tried. The new radio device does the same thing [illegible] and easily, by the turn of a switch.

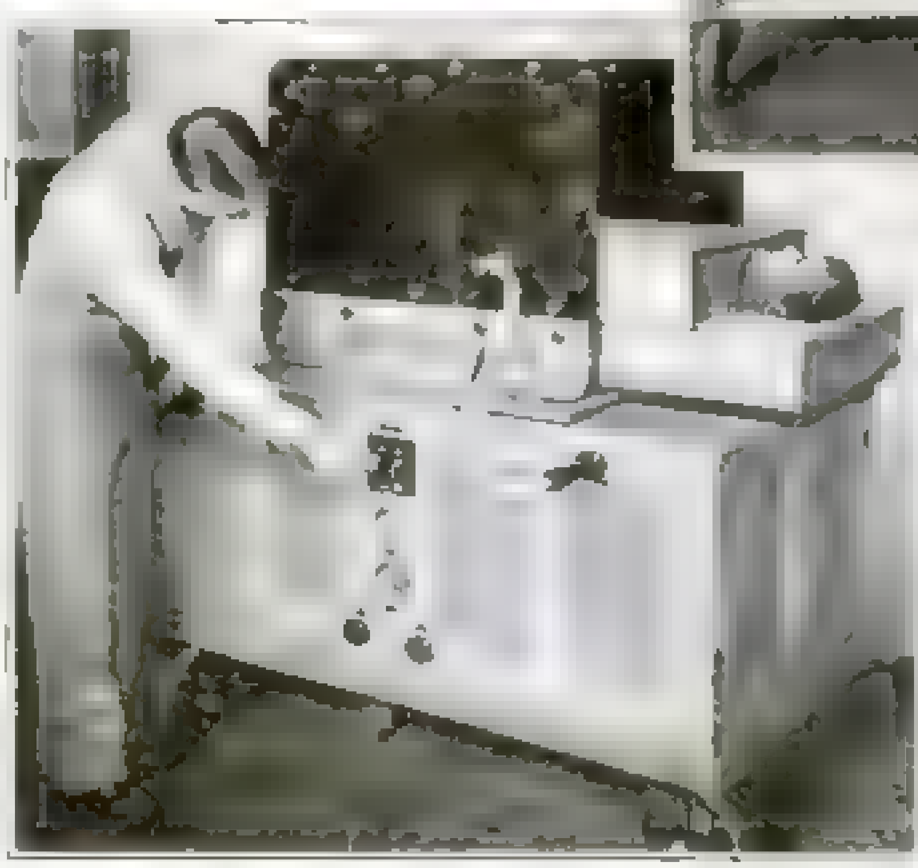
This is the first practical [illegible] of a powerful, short wave radio tube developed some time ago at the General Electric Company's Schenectady, N. Y., plant (P. S. M., June '28, p. 43). The "mystery" tube made weird, greenish yellow flames leap from exposed pieces of metal near it, and workers in the laboratory found the temperature of their blood raised and an artificial fever produced. Stray electrical currents which the [illegible]

[illegible] use a pair of the [illegible] are housed in a six foot case. The [illegible] short wave impulses they produce—thirty meter waves, one tenth as long as those of an average radio broadcasting station and vibrating approximately ten million times a second—are fed to two aluminum condenser plates covered with hard rubber to prevent sparks, which serve as an "aerial." The patient lies in a wooden and composition board box between the two plates. [illegible] and the [illegible]

At present, until its use [illegible] proved, the device is being made for experimental purposes only. Later it [illegible] standard medical equipment.

If there is merit in artificial fevers, says Dr. Willis R. Whitney, director of the General Electric Research Laboratory, [illegible] whose temperature tolerance is [illegible] A [illegible] produces heat within the tissues [illegible] this way of applying heat should be studied in member and joint diseases."

[illegible]

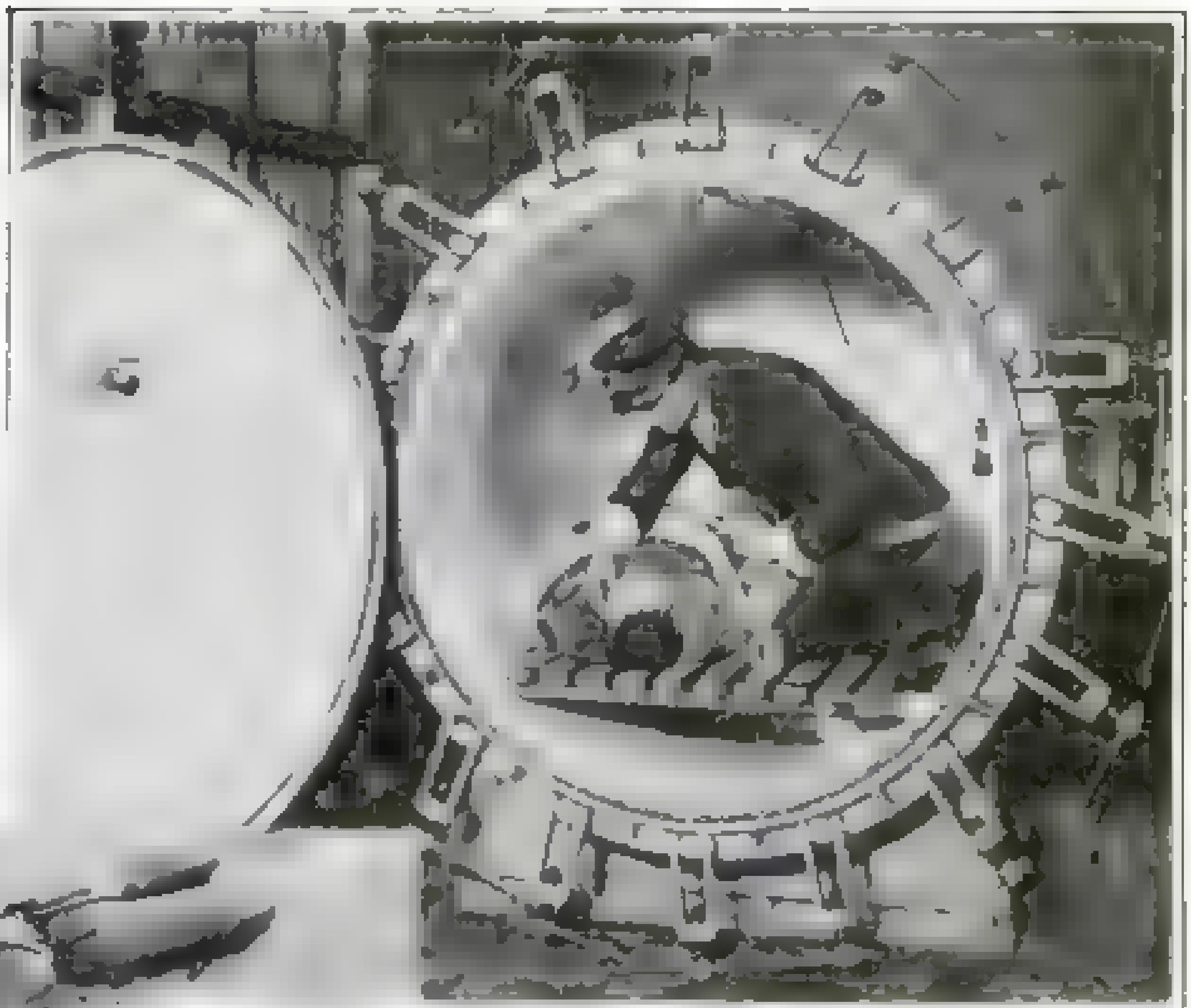


To produce an artificial fever by radio, the patient is placed in a box between two electric plates, between which short radio waves pass

"IRON DOCTOR" USED TO CURE DIVER'S BENDS

An "iron doctor" for divers who come up too suddenly has just been perfected by the British navy. The device is a pressure chamber in which compressed air simulates the weight of water under which divers work.

At great depths gas from the air dissolves in divers' blood. Sudden ascent from the bottom of the sea releases the pressure, and the blood becomes filled with bubbles of nitrogen gas. The result is the painful and dangerous malady known as "bends," or caisson disease. The remedy, as carried out by the new "iron doctor," is to restore the original pressure and then to release it very gradually. During the entire time the remedy is being applied, an officer remains in the "iron doctor" with the victim. It is his part to see that the air pressure is reduced at exactly the right rate and that no undue physical effort on the part of the patient interferes with his recovery.



The diver blown to the surface is rushed into the "iron doctor," a pressure chamber in which compressed air reproduces the water weight. Here the chamber is open with men inside.

Too much air pumped into his suit has shot this diver to the surface. Only quick aid can prevent the disease called "bends."

GAS VICTIM SAVED BY AUTOMATIC MACHINE

An emergency rescue device for restoring victims of gas poisoning, which can be carried about as easily as a suitcase and does the work of two first aid men has just been adopted by the fire department of Birmingham, England. It applies "artificial respiration," or forced breathing automatically. The apparatus comprises a machine which massages the heart and abdomen, and at the same time feeds a steady stream of oxygen to the stricken person's lungs.

Two men are not as efficient at restoring one poisoned with gas as this device, which automatically massages abdomen and feeds oxygen to the choked lungs.

THOUGHT EASIEST OF ALL WORK

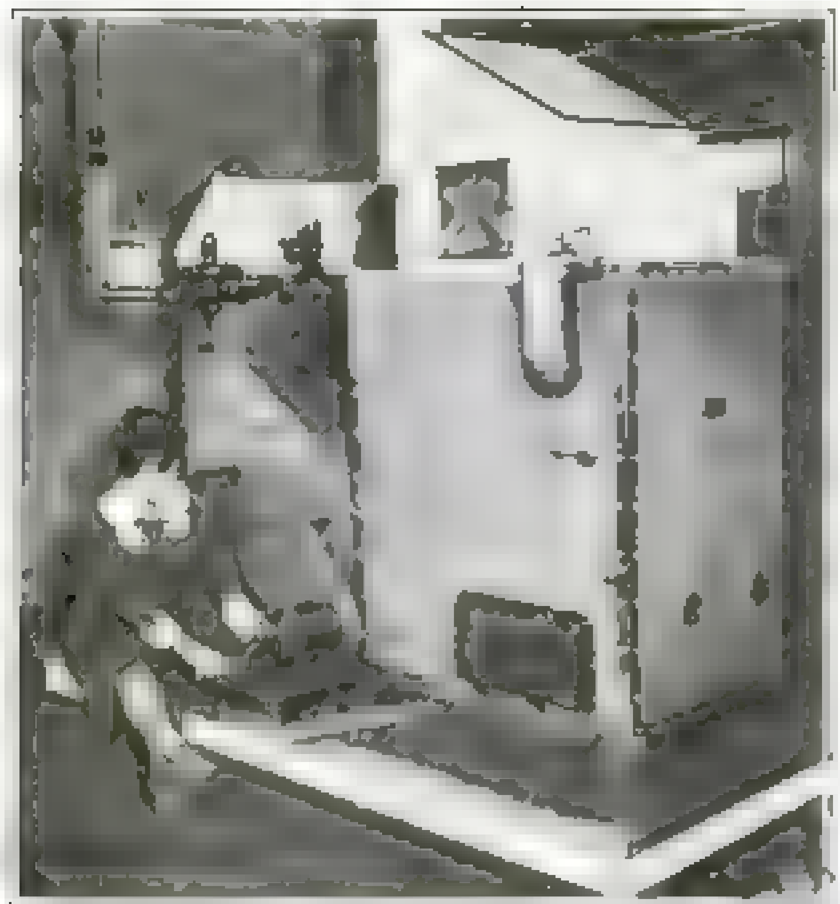
How much energy does it take to think? Recently Dr. Francis G. Benedict, nutrition expert of the Carnegie Institution, Washington, D. C., gave several subjects problems in mental arithmetic, and observed the amount of oxygen they used up in breathing—a measure of body energy. His conclusions were:

The professor who concentrates for an hour on a knotty problem burns up no more food than the maid who dusts off his desk for five minutes. One hour's intense mental effort uses up just about the amount of energy contained in one oyster cracker or half a salted peanut.

SEEK METAL TEN TIMES STRONGER THAN STEEL

Huge airships several times as large but no heavier than those now constructed, higher towering skyscrapers, and bridges three or four miles long may be built in the future if methods can be devised for making the atoms of metals cling together more tenaciously.

The improved metals which would result from the discovery of such methods, says Dr. Robert F. Mehl, of the Naval Research Laboratory in Washington, D. C., might revolutionize the engineering industry. Steel might be made which could bear ten times the load borne by ordinary steel. At present, for example, a steel bar one inch square can support a weight of about 170 tons. But a bar of pure iron whose every atom was holding tightly to its neighbor ought to support nearly 900 tons without breaking, Doctor Mehl affirmed. The tensile strength of this quality of iron would be so great that wire made from it having only twice the diameter of a human hair would support a man of 150 pounds. Such wire, utilized in the radio industry for winding the tiny coils of headphones, might even be used for sustaining ballet dancers in mid-air above the stage, and it would of course be invisible to the members of the audience.



SUMMER DAYS AT WILL WITH WEATHER MAKER

Summer days, autumn nights, or almost any seasonal atmosphere may now be created in the home with all the ease of turning on the radio. This is made possible by the recent invention of a "homemade weather" machine. The apparatus can either warm or cool the air in the house, give it a thorough washing or subject it to a drying process. It heats homes with gas fuel. If the housewife wants the effect of balmy zephyrs in her living room, she has merely to regulate the automatic weather man in her cellar.

THREE NEW WAYS TO FIND FLAWS IN WELDED STEEL

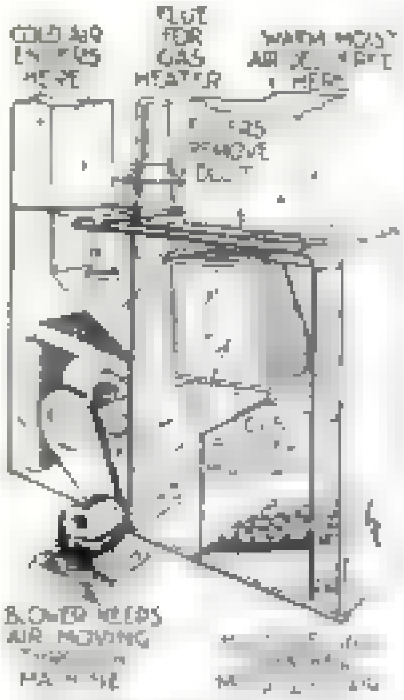
Flaws in welded structures and other steel pieces that are in actual use may now be detected on the spot by three testing methods, each of which was demonstrated recently at Lehigh University, Bethlehem, Pa.

The methods call into use three distinct scientific discoveries: the principle of electromagnetic induction, the physician's stethoscope, and the X ray.

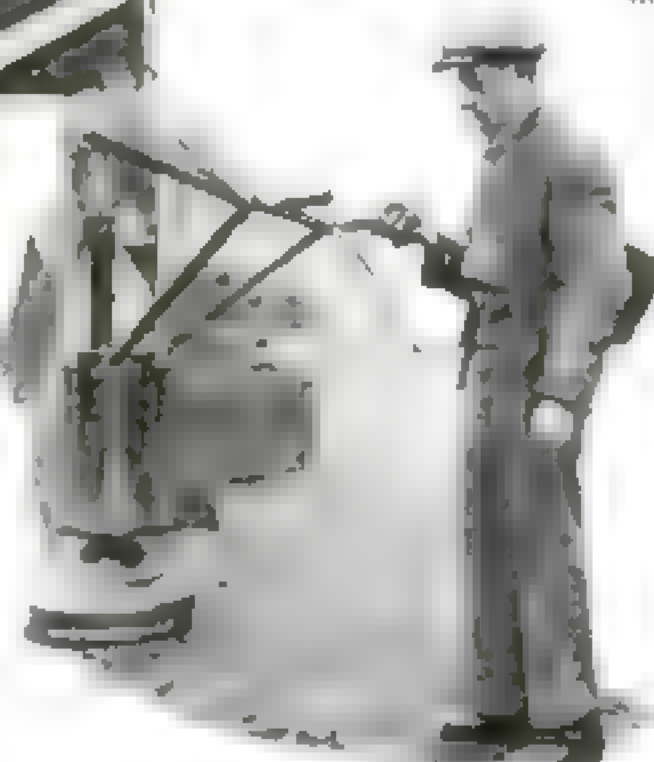
By the first method any crack in a welded piece betrays itself by movement of the indicator attached to a wire coil in which a current is induced by an electromagnetic field surrounding the welded section as the result of a strong current that is shot through it.

The second method uses the stethoscope in much the same way as the doctor would use it. The mouth of the instrument is placed against the steel where a flaw is suspected, while the examiner taps the area with a hammer. The ring of a cracked section is detected just as an unusual heart sound can be heard by the physician.

The last method involves the use of X rays. These are said to lay bare the inner structure of a steel section just as they will show a break in a bone or a dark spot in a person's lung.



This diagram will help you understand the weather machine



GERMAN ROBOT STAMPS TURF BETTER THAN MEN

Football fields, polo grounds, and areas of turf that require stamping need no longer present a labor problem if a new machine shown in Leipzig, Germany, is all that it is said to be. This novel "earth beater" does away entirely with the need for human effort. The machine pounds the ground with powerful automatic blows.

Like a monstrous sized upright frog, it leaps up and down, landing each time with full force and weight to flatten the turf with its huge bell-shaped foot. The operator has merely to stand by and let the willing robot do the job much better than he could do it himself.

COTTON HULL SUGAR IS SWEET, WON'T FATTEN

A sweet that doesn't fatten is the United States Bureau of Standards latest contribution to the sugar industry. The new sugar, known as "xylose," sweetens food but is not assimilated by the body. Through a new process, it may be produced for little more than five cents a pound, the actual cost of extraction. Formerly a pound cost as much as $100. The new low cost is obtained by making it from a waste product—bran from the hulls of cotton seeds—of which a million and a half tons are available.

This is not the first revolutionary accomplishment of the Bureau of Standards' sugar section. About seven years ago the Bureau introduced "corn sugar," or dextrose, made from corn, and found that it had created a new industry. One of its chemists went to the Edgewater, N. J., plant of a large corn products concern and at once produced 4,000 pounds of crystalline corn sugar. Offered a flattering salary to remain, he obtained permission to resign from the Bureau and started commercial production. Other firms followed, and today one company alone is producing more than a million tons of corn sugar daily. It is used by restaurants, bakers, laundries, and cosmetic and various other manufacturers.

TWO-EYED MICROSCOPE SPOTS FALSE PEARLS

Rapid and unerring examination of pearls is now performed with a "pearlometer," an instrument devised by an Austrian inventor. It consists of a huge binocular, double-eyed, microscope equipped with an unusually powerful light apparatus for laying bare the innermost heart of a pearl.

Light rays from an electric lamp at the base of the microscope pierce the pearl after being collected and concentrated by a "condenser," while auxiliary rays penetrate the pearl from a lamp directly at its side. For examination, the gems are placed on a little revolving table under the twin eyes of the microscope. A "cultured" pearl, that is, one produced by artificial stimulation of the oyster, will betray itself by peculiar stripes which appear when the pearl is revolved into a certain position with respect to the light rays. A drilled pearl, one pierced for stringing, reveals its secrets with the aid of a "prismatic" needle inserted in its drill channel, which permits examination of its insides.

Under this powerfully lighted, double-eyed microscope a pearl's value is easily found

Sugar Will Give You Endurance

Colgate University tests offer startling proof of man's dependence on sweet.

Tenseness of muscle caused by fatigue is registered by the instrument on wall. Eating sugar is found to lessen this fatigue.

By JAMES W. BOOTH

IS OLD MAN PAR too much for your golf game? Are you too slow on the trigger when the traffic lights change from green to red?

If so, the chances are that you don't eat enough sugar.

The man who makes a hole in four while his opponent takes five or six, does so because of a well-balanced coördination of mind and muscle. The driver who is never "bawled out" by a cop because he always stops the instant the red lights flash enjoys his immunity for the same reason.

Nothing new in this? Right. But that the coördination is influenced considerably by the kind of food one eats is a decidedly new discovery. It was made by Dr. Donald A. Laird, director of the psychological laboratory at Colgate University, Hamilton, N. Y., as a result of tests completed recently.

The person who eats a well-balanced diet, he found, including enough carbohydrates—that is, sugar and starches—is more alert and mentally more active than one who does not. His coördination between mind and muscle is more evenly balanced and he has more energy and stamina.

As subjects for his experiments, Doctor Laird took twelve Colgate students and divided them into two groups. These groups of six men each were tested for six days. One group was given "cocktails" consisting of 2.3 ounces of sugar in a solution flavored with lemon forty minutes before engaging in exercises and undergoing tests. This mixture the six men drank on the first three days. The last three days they were treated to a saccharin solution flavored with lemon. The other group was given saccharin "cocktails" exclusively, and those only on the first three days.

Reaction speed is measured by this instrument. Sugar, according to Doctor Laird, increases and speeds up process of coördination.

Why was sugar and saccharin chosen for use in the experiments? Because Doctor Laird explained, sugar is rapidly assimilated and is recognized as a highly concentrated energy food while saccharin, though many times sweeter than sugar, has none of the latter's energizing qualities.

By arranging his two squads as he did, Doctor Laird had a chance to test the energy-producing value of sugar preceding exercise in two ways. First, he could compare the performance of the group which took sugar the first three days with that of the squad taking saccharin in the same period. Secondly, he was enabled to check the prowess of the first group during the first three days, when the men drank the sugar "cocktails," against its performance during the last three days, when they had saccharin.

[illegible] and lemon, are given athletes, then energy tests are made.

Forty minutes after each student had swallowed his solution, Doctor Laird put him through his paces. First the men were given a series of tests. Then they were made to climb three flights of stairs. After that the tests were repeated. Giving the students the tests twice enabled Doctor Laird to make critical comparison of any gain or loss of energy, stamina and coördination produced by taking sugar or abstaining from it before exercise.

One of the most interesting of the tests, especially from the point of view of the motorist, was that

(*Continued on page 115*)

Bowlus Teaches Me

Twenty years in airplanes failed to give a veteran pilot the thrill he got when a sailplane carried him on the wings of the wind.

By ASSEN JORDANOFF

"THERE'S where we'll hop off," Hawley Bowlus told me.

He pointed to the top of a 165-foot ridge. It lay between the pounding Atlantic and the gray waters of Long Island Sound. We were near Montauk Point at the eastern tip of Long Island. I was about to make my first flight in a soaring plane, in the ship that Lindbergh flew and which POPULAR SCIENCE MONTHLY had bought for me to fly. Bowlus, America's soaring champion, was to show me how.

Ever since I used to scramble up the roof of my home in Bulgaria, as a boy, to watch storks sail past in silent flight, I have wanted to fly like a bird. Eighteen years in the cockpits of a hundred motored planes have not satisfied that desire. When a roaring engine drags you through the sky, you don't feel you are really flying. Only in coming down with the engine off do you taste for a moment the thrill of soaring on outstretched wings.

"Ever fly a glider before?" Bowlus wanted to know when POPULAR SCIENCE MONTHLY arranged our first meeting several days before our expedition to Montauk Point.

"I built a double-decker when I was fourteen," I told him. "It was the first glider in Bulgaria and caused a lot of excitement. Everything was all right as long as I stuck to jumping down hillsides. But I got ambitious. I tied a long rope to a Ford and started to make a towed flight. The driver got mixed up and started *with* the wind. I ran behind holding up the glider by the arm rests. I was making jumps like a kangaroo by the time my legs gave out and I let go. The glider lit on one wing tip and pinwheeled for a block."

Bowlus laughed. "That's almost the same thing I did in one of my early machines. Only I had it hitched to 'Old Cap,' my father's race horse."

Bowlus built his first glider in 1911. The sailplane in which I flew was his eighteenth design. In a similar ship, a few weeks ago, Jack Barstow circled over Point Loma, California, for more than fifteen hours, winning a $2,000 prize and setting an unofficial world's record. Bowlus, himself, holds a transport pilot's license and has had 2,300 hours in the air in motored planes. He is tall, has a quick happy smile, and you immediately like him.

"COME out to the New York City airport tomorrow," Bowlus told me that first time we met, "and I'll let you hop in a primary glider I'm assembling there." I jumped at the offer, and the next day, with the glider towed behind an automobile, I sailed kitewise across the airport a dozen times. Then we were ready to try real soaring at Montauk Point.

The dismantled soaring ship made the trip on a compact auto trailer. With Bowlus at the wheel of the towing car, auto and trailer climbed like a mountain goat to the top of the ridge. While we were assembling the plane, Bowlus explained its construction.

The wide wings are built in three parts, a center section and two outer ones. The ailerons extend from the extreme wing tips.

"They give greater leverage there," he explained. "It is easier to lift a wing at its end than nearer the fuselage." I thought these balancing surfaces looked small, when I first saw them. But in the air I found them highly effective.

IN LESS than twenty minutes, five of us had put the ship together. It has been assembled by three men in ten minutes. When the tail surfaces are attached the controls are automatically hooked up and the machine is ready to fly.

A gull circled in from the Atlantic and eyed the pure white sixty-foot bird on the hilltop. Whenever Bowlus flies over Point Loma, he has a string of curious birds trailing his noiseless sailplane. Pelicans and hawks, as well as sea gulls, have kept him company during the long flights in which he successively broke the American endurance record four times in almost as many months.

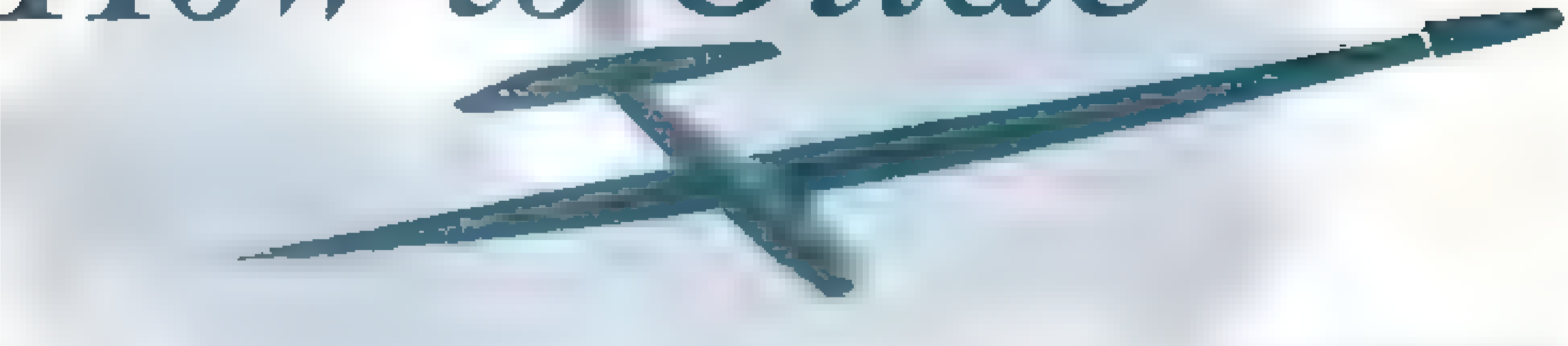
The gull flapped its wings to catch up with some air current.

"That bird's dumb," Bowlus declared. "It didn't need to flap its wings. It could have gone on soaring if it had turned a little to the left. There's an up-current there." A few minutes later, he flew over the spot and proved that there was rising air where he had indicated it would be found.

"Anybody that can tell birds how to fly, can tell me," I concluded.

If anybody *can* give birds pointers it is

How to Glide



The great white ship h[illegible] ering like a bird [illegible] ridge at Montauk Point, L. I., just after the shock cord has dropped from the [illegible]

Just before the take-off. Jordanoff (right) is receiving final instructions from Bowlus. "Always turn into the wind," Bowlus tells his pupil.

Bowlus. He knows [illegible] they fly [illegible] He [illegible] studied [illegible] years. He [illegible] [illegible] of reels of motion pictures of birds in flight which he runs slowly through the projector for study. In some of his early experiments, he even stuffed hawks and buzzards with their wings extended and launched them from the hillsides in an effort to learn how they soar.

IN BUILDING his sailplanes, he has combined this knowledge of bird flight with his training in airplane construction. He was in charge of the Ryan plant when Lindbergh's *Spirit of St. Louis* was built there. As a result, he has built a machine with a wing spread of sixty feet that has a factor of safety of five yet weighs less, per square foot of lifting surface, than a sea gull. The wing loading of the Bowlus soaring ship is only one and one quarter pounds a square foot. In building his first sailplane, he used paper ribs to cut down the weight. His latest craft has light wooden ribs of great strength.

A steady twenty mile-an-hour wind was blowing out of the northwest, across a bay of the sound, directly against the steep slope of the ridge. Before we finished assembling the plane, wind-borne fog began rolling up the slope. In five minutes the foot of the ridge was invisible. The world became a sea of gray mist. Ragged plumes of fog raced over the hilltop, carried by the wind.

"Notice how that fog follows the curve of the hilltop," Bowlus pointed out. "Most people think [illegible] rising currents are next to the slope, but they aren't."

"Where are they?" I asked.

"Out [illegible] the slope a hundred feet or more. When I take off on a soaring flight, I usually kick over the rudder as soon as I get clear of the brow of the hill. This skids the ship around sidewise through the air, slowing it down, so I pass through the rising column at slow speed. A shock cord launches a plane sometimes at forty five miles an hour. If you fly straight out, you may speed through the up-currents without getting much benefit from them. Always turn or skid, to slow down the ship, in an up-draft, go straight ahead in a down-draft. The problem of the soaring pilot is to get through down-currents as quickly as possible and to go through up-currents as slowly as possible."

IT GREW lighter. The fog was blowing out to sea. Bowlus laid out the shock cord on the ground so it formed a great V with fifty-foot legs. The point of the V was attached to a metal hook below the nose of the machine. Six of us took our places near the two ends of the rubber cable, three on each leg, ready to run at the signal. It was not necessary to hold back on the tail of the machine, as is the case with primary gliders. The weight of the sailplane, about 220 pounds with its pilot, is sufficient to hold it, by friction, until the cord is stretched for the launching. Bowlus took his place in the cockpit, tested the controls, then called

"Ready? One, two, three, run!"

WE DUG in our toes and dragged on the rubber cable. Just before we reached the brow of the ridge, it became slack in our hands. It had dropped from the hook. The sailplane was in the air.

For a moment, the huge white bird seemed to hover overhead as it moved at slow speed against the wind. Then it made a sweeping turn and sailed along the slope, soaring upward on the rising currents.

In elongated figure eights, Bowlus cruised along the ridge. He always turned into the wind, away from the ridge. Later, I asked him why. He explained that there is danger of being carried by a strong tail wind against the slope if a turn is made in its direction. More than that, turning

Bowlus shows Jordanoff that the primary glider which he designed for preparing soaring students . . . Like the sailplane it is manipulated by regular airplane type controls

into the breeze slows down the soaring ship so it takes longer to pass through the up-currents, and gains greater altitude from them.

"In a turn," he said, "make as shallow a bank as possible. This keeps the wings nearly level and gives the rising currents a greater area to lift upon. In many turns, I have such a slight bank that I skid as much as 150 feet before I am headed around the other way. When I am soaring in light breezes, I have found that I can sometimes gain altitude by crabbing with the windward wing up. This allows the full force of the up-currents to get under the sustaining surfaces and give their maximum lift."

Bowlus landed with a long slow drift. It carried him nearly three quarters of a mile away, where he slid to a gentle landing in one of the few open spaces free from boulders. Over most of the slope, brown rocks were scattered.

We drove down to the machine to pull it to the top of the ridge again. Bowlus was sitting on the nose of the fuselage. The first rule of motorless flying, he says, is to stick to the ship until someone has hold of the wings. If a pilot jumps out and leaves the plane headed into the wind, a gust may somersault it backwards and wreck it.

"You're next," he shouted. "The air's fine." A crow, passing overhead, cawed derisively. "He's just sore because he can't soar," Bowlus said.

Before we could get the machine in position again, the waters of the sound and the ocean had disappeared in haze. Fog was again rolling up the slope. We could hear the breakers pounding on the shore. I had visions of being lost over the Atlantic in fog, without a motor. And I love cold water like a cat.

But Bowlus decided to make another flight first. That suited me fine. He thought he had missed a few good air currents on his first trip. He collects air currents as some people collect rare books. He prowled along the edge of the ridge, watching thick patches of fog race over the brow of the elevation, showing how the air currents moved. Sometimes smoke from smudges is sent up the hillsides to show where the air currents are rising best. Bowlus first tried toy balloons for the purpose. They were useless, as they often zoomed up as though in the grip of a powerful up-draft. But when the soaring ship passed over the same spot, it received no lift at all. The conclusion was that the small balloons were caught in tiny columns of heated air too small to affect the large plane.

When the fog cleared, Bowlus made another beautiful flight. For more than a quarter of a mile he skimmed close to the ground in landing. The graceful ship would touch and then be lifted again by small currents formed by the wind blowing against the irregularities of the slope. He had almost reached the water of the bay before he stopped. That worried me. The water of the bay looked just as cold as that of the Atlantic. Would I be able to land before I reached it?

I asked Bowlus: "If I glide straight out, how far will I go?"

"Oh, about to the middle of that bay," he told me. Right then and there I knew I was going to do some turning on my first flight.

"All ready?" he asked. I climbed into the machine and he gave me the final instructions. The controls in the cockpit were the same as on a regular airplane. My right hand held the upright stick that operated the ailerons and the elevators, balancing the wings and pointing the nose up and down. My feet were on the pedals that moved the rudder to steer to right or left. But my left hand had a vacation. There was no motor throttle to operate.

The Bowlus sailplane is being unloaded from the compact auto trailer upon which it was carried to the gliding scene on Long Island. It can be assembled in ten minutes

I was sitting low in the streamlined fuselage. A cushion was on the seat. My head rested comfortably against the bulkhead to which the main wing was attached.

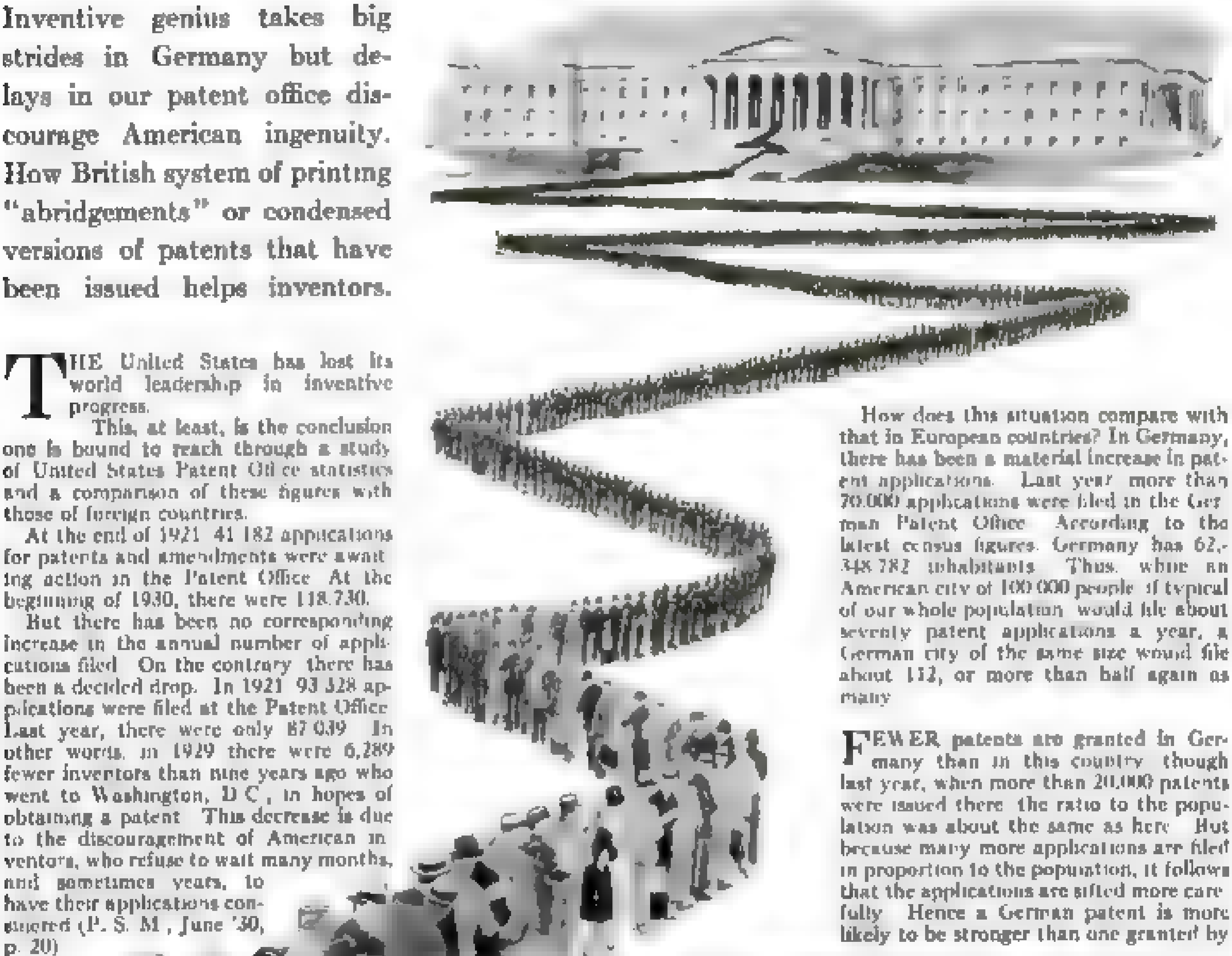
"On the take-off," Bowlus explained, "hold the stick in neutral. The shock cord is attached to the hook far enough under the nose so its pull automatically increases the angle of attack and the machine continues to climb as long as the cord pulls. When the shock cord drops off the hook, feel the

Continued on page 114

What Europe Can Teach Us About Patents

By EDWARD THOMAS

Inventive genius takes big strides in Germany but delays in our patent office discourage American ingenuity. How British system of printing "abridgements" or condensed versions of patents that have been issued helps inventors.



THE United States has lost its world leadership in inventive progress.

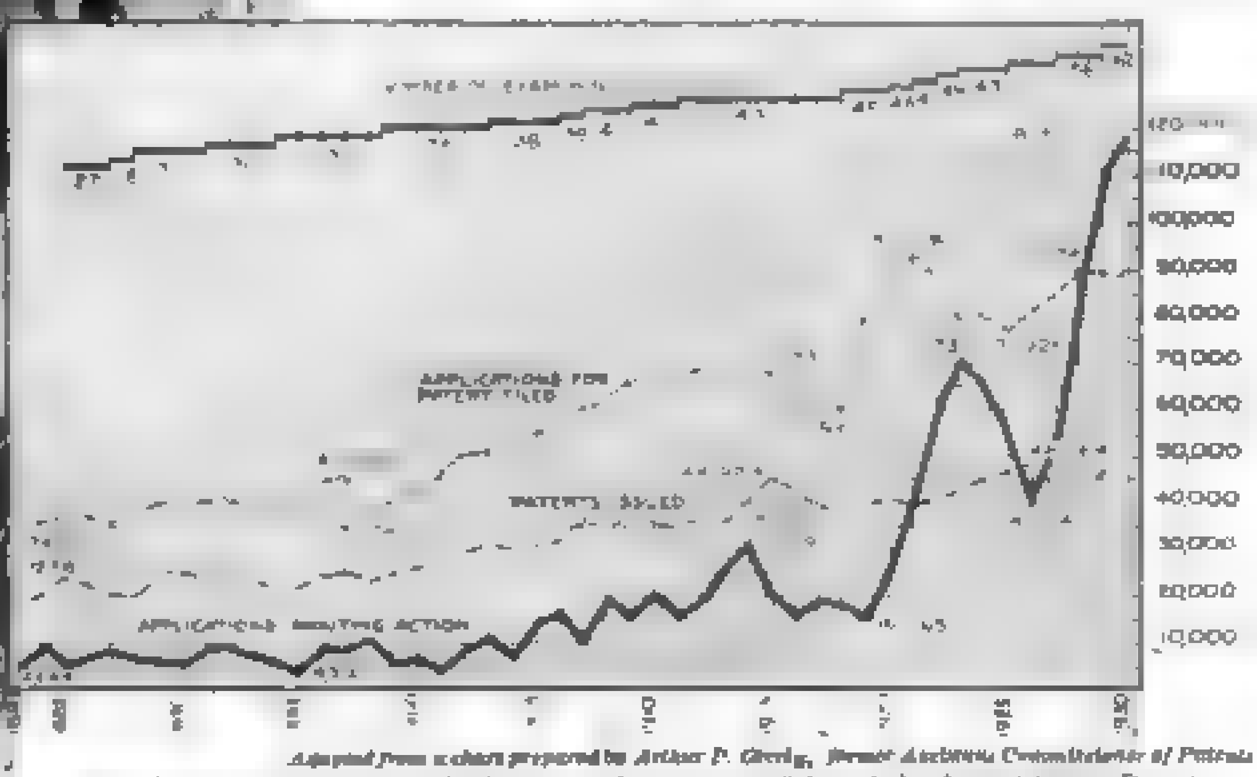
This, at least, is the conclusion one is bound to reach through a study of United States Patent Office statistics and a comparison of these figures with those of foreign countries.

At the end of 1921 41 182 applications for patents and amendments were awaiting action in the Patent Office At the beginning of 1930, there were 118.730.

But there has been no corresponding increase in the annual number of applications filed On the contrary there has been a decided drop. In 1921 93 328 applications were filed at the Patent Office Last year, there were only 87 039 In other words, in 1929 there were 6,289 fewer inventors than nine years ago who went to Washington, D C, in hopes of obtaining a patent This decrease is due to the discouragement of American inventors, who refuse to wait many months, and sometimes years, to have their applications considered (P. S. M, June '30, p. 20)

How does this situation compare with that in European countries? In Germany, there has been a material increase in patent applications. Last year more than 70.000 applications were filed in the German Patent Office According to the latest census figures Germany has 62,348 782 inhabitants Thus while an American city of 100 000 people if typical of our whole population would file about seventy patent applications a year, a German city of the same size would file about 112, or more than half again as many

FEWER patents are granted in Germany than in this country though last year, when more than 20,000 patents were issued there the ratio to the population was about the same as here But because many more applications are filed in proportion to the population, it follows that the applications are sifted more carefully Hence a German patent is more likely to be stronger than one granted by



Adapted from a chart prepared by Arthur P. Greeley, former Assistant Commissioner of Patents

This chart gives at a glance the history and present condition of the United States Patent Office. The climb of the heavy line shows how number of applications awaiting action piles up.

Interference proceedings to establish priority of patents have proved to be a curse to many an American inventor

Edward Thomas, the author of this article, is widely known as a patent lawyer and as the author of standard books on patent law. He was formerly assistant examiner in the United States Patent Office and has studied at first hand the patent systems of Europe. Thus what he has to say on the patent situation is the result of careful study backed by long experience.

the United States Patent Office.

The German patent office examiners seem to make more thorough searches than their American colleagues. Perhaps this is due to the different method of organization. A patent application in Germany first goes before an examiner, as it does in the United States. But his report, instead of being final, as it is here, is only a recommendation to his superiors. Thus Germany provides a check on the examiner.

THE patent system of Great Britain is too different from ours to be directly comparable in the same way, but the number of patents issued in England indicates that Great Britain is at least abreast of the United States in inventions protected by patents. It should be understood that, in speaking of patents, the term Great Britain is meant to include England, Scotland, Wales, and northern Ireland. The Irish Free State and the many colonies and dominions have their own separate patent offices.

Great Britain grants approximately 30,000 patents a year on about 36,000 or 37,000 applications. Thus about eighty percent of the British inventors who file applications at home get their patents. In the United States, the percentage is about fifty.

This avoidance of waste of time and money spent in useless applications probably is made possible by the excellent system of publishing all patents issued in condensed form, known as "abridgements." Every patent is skilfully summarized when passed on by the examiners. These summaries or abridgements of issued patents are published every few months and later compiled in book form, arranged by classes of inventions.

An inventor can buy the published volumes or individual pages of abridgements of any class of invention in which he is interested, or consult them free of charge in the public libraries, and make searches himself without the trouble and expense of hiring a patent searcher or attorney. Moreover, he can search the abridgements to find solutions of minor problems that face him in the working out of his broad principle or invention.

The United States could make no greater contribution to the world's inventive progress than to imitate and, if possible, improve upon the British system of publishing books of abridgements. The present Official Gazette of our Patent Office publishes only selected claims of the patents issued. And though they are supposed to be definitions of the patented inventions, they are inadequate and would be unsatisfactory even if the claims were grouped by classes of inventions, which they are not. The making of abridgements of all United States patents already issued might cost from $2,000,000 to $20,000,000, but would be worth hundreds of millions of dollars to the country.

The hopeless and progress-impeding delays that clog the machinery of the United States Patent Office are unknown in Great Britain. They are not possible there. The law forbids them. The British law requires that, in ordinary circumstances, every patent must be ready for issue within fifteen months after filing of application. Under special conditions, this period may be extended to eighteen months. But if not completed within that period, the application is legally dead.

THE British office has found it possible to live up to that law and yet turn out good patents. In the United States, there is no such limitation set by law. Legislation of that kind would go a long way toward clearing up our Patent Office muddle.

In fairness to the American system, however, it should be realized that the British examiner is required by law only to search inventions patented in Great Britain in the previous fifty years. In the United States, he is supposed to cover patents issued anywhere in the world since the beginning of time, besides such descriptions and drawings of similar devices and processes as he may be able to find in scientific and other magazines or in textbooks published anywhere at any time.

Theoretically, this is the only way to give the inventor a fair deal, but it has not been worked out adequately in practice in the United States Patent Office. In Germany, virtually the same rules apply, but the officials in that country have coped more successfully with the difficulties. There is no reason that I can see why the wealthiest country on earth should not be able to command a staff of examiners that would be at least the equal of the best experts on the German force.

Comparison with France, Belgium and many other countries cannot be made because they have no system of searches by examiners. Holland now makes examination of patent applications. That country was the last civilized nation to establish a patent office. It was opened in 1910.

Without rising from my chair I can lay my hands on abstracts of about 30,000 magazine articles and chemical patents

TO SEARCH the inventions of the entire world from the beginning of time through tons of literature may seem a formidable job, but knowledge nowadays is so well classified that, with adequate indexes, a well-trained and careful worker need not find it impossible or even difficult to find his way in it.

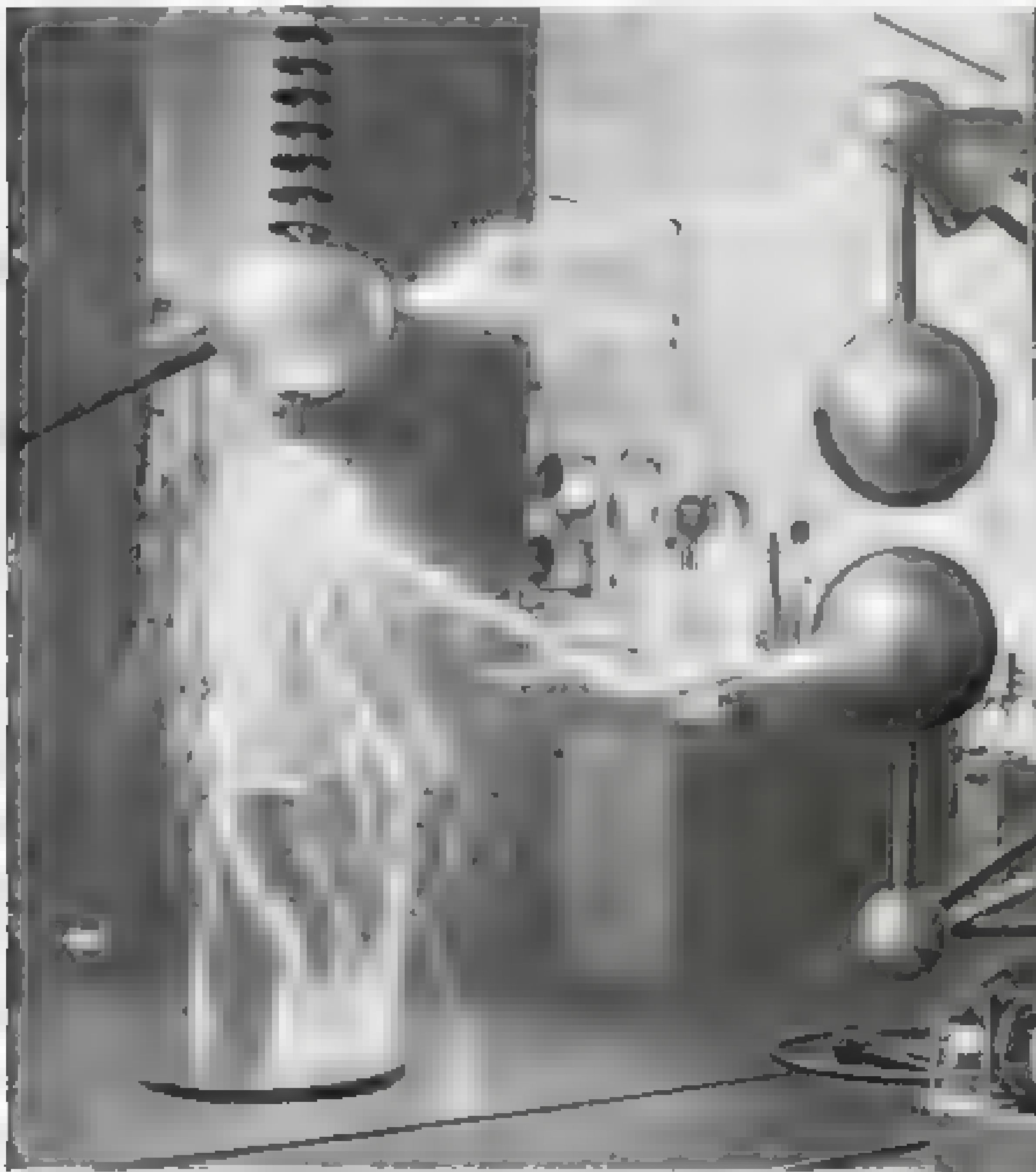
Let me give an illustration from my own experience. In my practice I specialise in chemical patents. The other day I was asked for advice by a hat manufacturer, who was threatened with suit for using a complex chemical with a name too long to print. I had to tell him that, if he could not prove the patent was worthless, he would be put out of business. He authorized me to investigate patents and any literature on the subject to see if this complex substance had ever been used before.

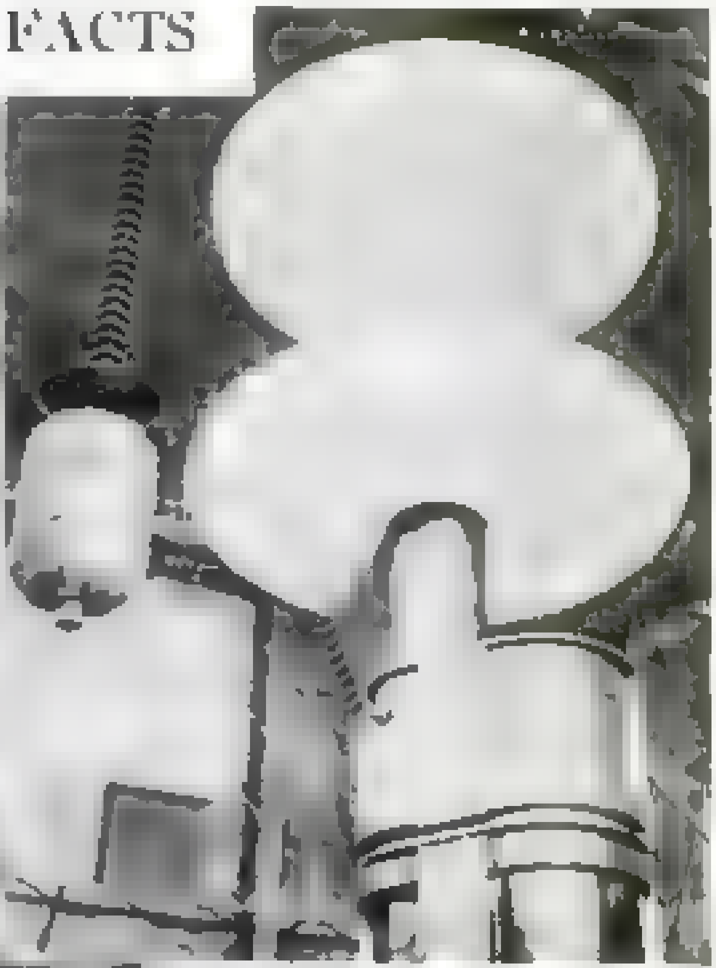
After just three days' work I came back to him with sev- (Continued on page 118)

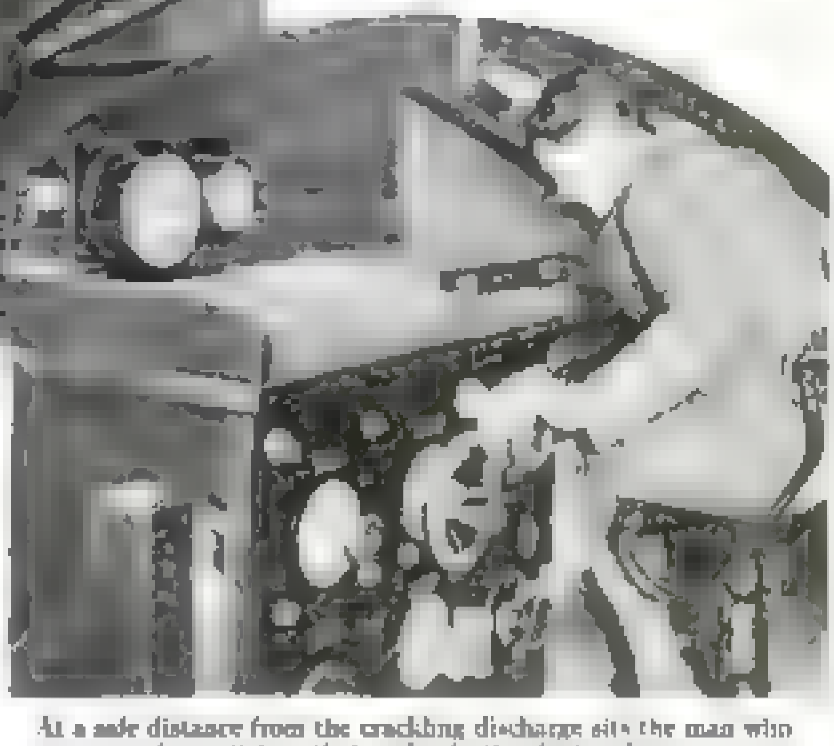
PROGRESS AND DISCOVERY

Important achievements in engineering, exploration, and discovery, and the latest news of the world's progress in science

MAN-MADE LIGHTNING GETS POWER FACTS







At a safe distance from the crackling discharge sits the man who operates the switches that unleash the high-voltage current

ONE man controls the power of a million volts, in the new high tension testing laboratory just opened by the Metropolitan-Vickers Electrical Company at Manchester, England. A [illegible] his fingers releases a blinding [illegible] [illegible] balls suspended in the testing room

Twelve-foot tongues of fire leaped to the ground from a great ball, hung on insulators, in the first demonstration, held recently. They were unleashed, at the turn of a wheel, from grotesque, mushroom-shaped condensers twenty feet in diameter that stored them. The operator was at a safe distance, for anyone near the balls would be killed instantly

The high-voltage laboratory will aid the study of the best designs for insulators and all the other equipment needed for a high-voltage transmission line. Its power is more than ample. The highest-voltage wires used for carrying power, which are in America, operate at 220,000 volts. High voltage is preferred for power lines [illegible]

[illegible] Falls to Rochester, N. Y., a distance of a little more than sixty miles would require about 5,250 tons of copper wire if operated at 10,000 volts. But if the voltage is increased to 20,000, the same transmission line would need only one fourth that amount of copper. And at 80,000 volts it would require only eighty-two tons of copper

If too great voltage is applied to a transmission line, however, it will spark over from one wire to another and short-circuit and leak from a wire into the air in a glowing discharge visible at night The photograph above shows vividly how a flash of three quarters of a million volts crackled through the air in all directions such a discharge cannot possibly be confined in wires of any length, experiments have demonstrated

Yet considerably more powerful flashes have been produced in electrical laboratories of this country Artificial thunderbolts of five million volts have been made at the General Electric Company's laboratory at Pittsfield, Mass., while the Carnegie Institution at Washington, D. C., has a huge transformer of equal power. Another high-voltage laboratory, where currents of two million volts are used in experiments, is that of the California Institute of Technology at Pasadena

STEEL HOUSES IN FRANCE HAVE METAL FURNITURE

GERMANY, England, and France are hotly contesting the leadership in the movement for the ultra-modern in architecture. So far Germany rather leads the race, but the steel houses, now being erected outside of Paris, are evidence that French architects are making a strong bid for first place. Based, as is almost all modern architecture, on geometric patterns, these Parisian houses go to extreme limits in an effort to avoid all past architectural ideals. Not only are the structures themselves entirely of steel, with interiors having walls and stairways of the coldest mathematical design, but even the furniture is metal. Closely packed rows of these square houses may soon replace the stone dwellings.

Built of steel, this new type of Paris home is expected to oust the stone buildings from favor

One of the new all-metal French homes in course of construction. The use of wood, even for furniture, is barred.

NEW EYEGLASSES GO INSIDE THE LIDS

COMFORT and better eyesight are claimed by the inventor for those who wear lenses inside the eyelids instead of in the usual "outside" spectacles.

The new glasses, devised by a German oculist, are an adaptation of the thin glass shells sometimes used to protect the cornea in cases of inflammation. The new lenses are said to be more effective than ordinary spectacles, as they turn from side to side with the eyeballs.

No irritation, it is claimed, of the eye or eyelid, and no interference with the flow of tears, will result if the internal lenses are properly shaped and ground. The inventor says that there is no great danger of injury to the eye in case of breakage, but other oculists are inclined to doubt this.

STUDY CELL WHIRLING UNDER MICROSCOPE

WHAT happens to a living cell of animal or vegetable matter when it is whirled at from 2,000 to 3,000 revolutions a minute can now be seen through a microscope. The apparatus that makes it possible is the invention of Prof. E. Newton Harvey, of Princeton University, and Alfred L. Loomis, banker-scientist of Tuxedo Park, N. Y.

Biologists are interested to know the structure of a cell, its toughness, and the relative density of its parts. A good way to study these things is to spin the cell at high speed.

The cell, on a glass slide or plate, is placed in a whirling frame beneath the microscope lens. A powerful, flickering mercury-vapor lamp illuminates it for a fraction of a second every time it reaches a given point in the revolution. The result is a clear, steady view, permitting an observer to watch the stretched cell or even to photograph it.

TROLLEY CARS NOW RUN 60 MILES AN HOUR

TROLLEY transportation entered the competition always going on among high speed passenger vehicles when twelve new street cars, capable of sixty miles an hour, were added recently to the West Penn System in the Allegheny Valley. The cars are so designed that their highest operating efficiency is better than forty miles an hour. Beside increased speed, other improvements are claimed for them. Small wheels, permitting a low center of gravity, will make them hug the road like a low-slung automobile so that they will not pitch or "nose."

MINERAL WATERS USED TO CURE SNAKE BITE

SNAKE bites, diphtheria toxin, lockjaw, and mushroom poisoning may all be combated by hypodermic injections of various [illegible] waters according to Dr. Gustave Monod of the famous mineral spring resort at Vichy, France. In a recent report to the [illegible] Dr. Monod [illegible] water from the spring [illegible] on injected into the veins of an [illegible] about it is claimed, an [illegible] Other claims [illegible] teracted the effect of diphtheria toxin, water from the spring of Mt. Dore neutralized the poison of mushrooms, and La Bourboule water offset the effects of lockjaw.

Dr. Monod suggested an interesting theory to account for these extraordinary physiological effects. He reminded his audience that mineral waters surge up from far down in the earth, passing over hot, primeval rocks from which they may acquire chemical ingredients peculiar to the organic matter from which life started millions of years ago.

LONGEST TUNNEL IN EAST TAPS JAPAN'S OIL FIELD

SHIMIZU TUNNEL, longest in the Orient and seventh longest in the world, drilled through the mountains of western Japan, is nearing completion. The tunnel, 31,831 feet or slightly more than six miles long, is more than 2,000 feet above sea level for its entire length, and cost $6,000,000. Work on it began in 1922 at the foot of Mt. Mogura. It has shortened the railway distance from coast to coast across the middle of Japan by sixty-one miles, and clipped four hours off the railway running time. The northwestern terminus of the new line is at Niigata, in the center of Japan's leading oil fields.

Other famous tunnels of this character are the Simplon Tunnel in Switzerland, 65,734 feet or approximately twelve and a fifth miles long, the Mont Cenis Tunnel in the French Alps, 42,150 feet or almost eight miles long, and the Arlberg Tunnel in Austria, 32,892 feet in length.

E. LeRoy Nichols, on swinging stage, puts New York on his map. Below, finishing Grand Canyon block

SWINGING STAGE USED TO MAKE GIANT MAP

MOUNTAINS, canyons, and plains of the United States are seen in startling prominence on a huge relief map rapidly taking shape at the Babson Institute, Wellesley, Mass. It is said to be the largest of its kind. From the Atlantic to the Pacific coast, the map measures sixty-three feet.

Constructed on the enormous scale of only four miles to the inch, the map covers the floor of an entire hall. Plaster blocks, each painstakingly modeled after Government maps, make up the surface, which is curved to resemble the earth.

E. LeRoy Nichols, who is in charge of the formidable task, began it three years ago (P. S. M., July '27, p. 64). One of the novel requirements of his work is that the plaster sections must be put in place from a swinging scaffold, this being the only way to reach the inner sections without damaging other parts of the map. It is expected that the completed map will be of great value to airplane pilots.

NECKTIES OF RUBBER LOOK LIKE SILK

NECKTIES of rubber are a novelty in France where they are declared to be attractive and practical. Sheets and threads of rubber are woven together in the French process, making a material resembling either silk or cotton at will.

Any color scheme may be used upon the rubber ties, which are made both in bow and four-in-hand shapes. When soiled, they may be cleaned with soap and water.

TWO-WAY PHONE SERVICE INSTALLED ON TRAINS

ON a crack express train of the Canadian National Railways, speeding at more than a mile a minute, a passenger talked by telephone with London the other day. The occasion was the inauguration of two-way telephone service from moving trains as a standard part of the railroad's equipment. Now a traveler may sit in a telephone booth on the train and call up any long-distance subscriber. He himself also may be reached by telephone and paged on the train.

The telephone apparatus, which ends the inaccessibility of train passengers, has now been opened to passenger service, following successful experimental tests (P. S. M., Aug. '29, p. 20). Connection between the train and the outside world is made through a radio aerial on the roof of the car that contains the phone booth. The speaker's voice, broadcast by the aerial, is picked up on telegraph wires that parallel the track and transferred to telephone wires, whence it can be sent by wire or cable to any part of the world. An outside subscriber calling a train passenger places a call with the long distance operator for "Mr. Blank, who is on a Canadian National Railways train which left Montreal this morning and whose destination is Chicago." A page boy on the train summons Mr. Blank to the phone, and the call is completed. In the tests, calls were made to London, Washington, Ottawa, and Fort Worth, Tex.

This is the first railway telephone system of its kind in the world. The German State Railways have a different system of communication. By throwing a switch an operator allows one-way conversation between a person on a train and another elsewhere. The switch must be changed each time a reply is made.

400-POUND WEIGHT TESTS WELDED RAIL JOINTS

THE strength of welded joints in trolley tracks gets a grueling test at the United States Bureau of Standards, at Washington, D. C.

A section of rail, held between two anvil-like supports, is rapped by a mighty 400-pound hammer once a second for as long as the rail will take the punishment. The huge hammer, a block of steel with a beveled base, falls from a height of six inches. Some rails may take as many as a million blows before they crack. The average rail, however, gives way under seventy thousand to one hundred thousand blows.

Leroy R. Sweetman, Bureau of Standards engineer, sets 400-pound hammer beating welded rail joint to test strength.

ENGLAND DIGS BIGGEST UNDERWATER TUNNEL

ONE million tons of rock are to be excavated in drilling a colossal vehicular tunnel now in the process of construction beneath the Mersey River in England. The tunnel will connect Liverpool with its companion city of Birkenhead on the opposite bank. When completed, the huge passageway will be the largest underwater tunnel in the world, engineering authorities say. Four lines of traffic will ply their way along it, and there will also be room for railway lines or another roadway.

A 200-ton shield forty-six feet in diameter is burrowing its way under the river, creating as it goes the long cylindrical path of the tunnel. This is believed to be the largest tunnel-building shield of its kind ever made.

The inventor of the tunnel shield, an English engineer named M. I. Brunel, is said to have conceived the idea from watching the action of a certain shipworm which bores tunnels through wood with a pair of shells at its head.

FIRST PICTURES OF PASTEUR INSTITUTE

[illegible] 8,000 [illegible] 12,000 [illegible] Pasteur Institute [illegible] Louis Pasteur [illegible]

[illegible]

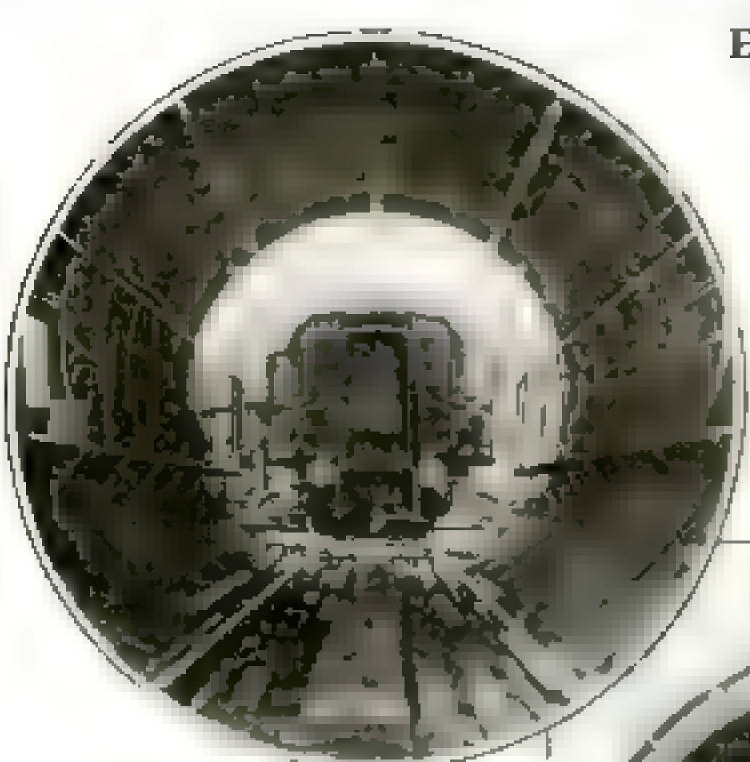
[illegible]

[illegible]

Where germs [illegible]

[illegible]

Heart of Far North Seen in Rare Photos



CLEAN RAILWAY CAR IN HUGE KETTLE

A gigantic cylindrical caldron that fills with gas and holds a railway car inside it is the remarkable expedient used by the German Federal Railway to kill bacteria and vermin.

After a car has been in service for a certain number of miles, it is brought to this fumigating plant. The huge cylinder, constructed like a section of a tunnel, receives the car on tracks at its base. Doors at each end are shut, and an air-tight compartment is the result. Formaldehyde gas, a powerful disinfectant, is then released within the enormous sterilizing kettle. Following a thorough bath in this atmosphere, the car is ready to take up its routine again.

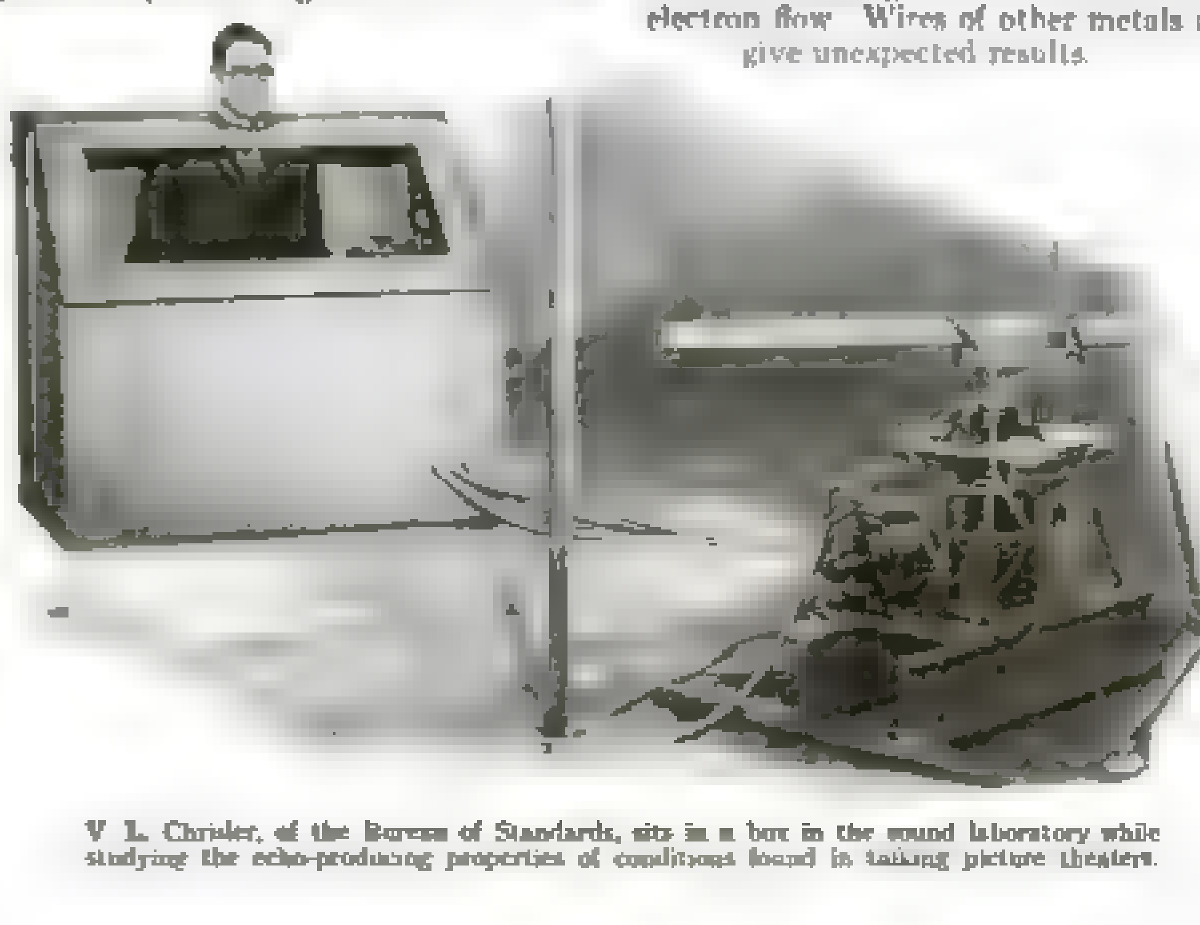
Two views of the huge kettle, big enough to admit a car, used in Germany in disinfecting railway coaches

SITS IN A CABINET FOR SOUNDPROOF TESTS

Because his clothing might deaden the sounds of voices just a little, an engineer at the United States Bureau of Standards new sound laboratory sits in a box.

The laboratory is a miniature theater where the acoustics of "talking movie" installations may be tested. The audience is made up of technicians of the Bureau. They hope to discover means of reducing the "echo effects" which many theater managers have had to combat since the advent of the talkies. It has already been found that not only the construction and the material of a theater's walls, but even the upholstery of the seats and the clothing of the audience have an influence on the reception of sound. So would the clothing of the experimenter if he were not inclosed in his self-imposed prison.

Most of the existing motion picture theaters cannot be readily and inexpensively altered to give them the sound-absorbing qualities demanded by the talkies. Hence, correcting echo effects through the use of upholstered seats may be one of the methods adopted. The Bureau workers have discovered a certain lime plaster which shows promise of being an effectual absorber of sound.



V. L. Chrisler, of the Bureau of Standards, sits in a box in the sound laboratory while studying the echo-producing properties of conditions found in talking picture theaters.

HELIUM KEEPS FOODS FRESH FOR MONTHS

One of the most remarkable of chemical elements is helium, the inert gas used to fill balloons and dirigibles. Although most people think of it in that connection, it has various other extraordinary uses. If a man with a deep "basso" voice should fill his lungs with helium, for instance, his voice would change to a high tenor. A sponge cake baked six months previously, if placed in an atmosphere of helium, can be made to taste as though it had just come from the oven. Orange juice preserves its flavor indefinitely under the influence of the gas. Toy balloons may be blown up and popped with lighted cigarette ends without danger of fire or harmful explosion. Divers, breathing a mixture of helium and oxygen, are said to be able to work at greater depths with greater comfort than is possible with the inhalation of ordinary air. Aside from the greater comfort experienced by the diver, the use of helium and oxygen mixtures in place of ordinary air for divers lessens the chance of "bends" during decompression because it does not dissolve in the blood stream as freely as does the nitrogen of the air.

Helium was not first discovered on earth, but in the sun. Sir J. Norman Lockyer, English chemist, found it in the sun's atmosphere in 1868. Sir William Ramsay in 1895 found it in earthly minerals, natural gases, and in minute amounts in the air.

ELECTRIC LAWS UPSET BY STRONGEST MAGNET

The world's most powerful magnet has just upset classical ideas of the way electricity runs through wires. So the Russian engineer who built it, P. L. Kapitza, recently reported, in describing the researches he had made at Cambridge, England.

The magnet is produced by short-circuiting the entire current of 10,000 amperes from a powerful generator through a two-inch coil of wire. An elaborate system of relays and switches allows the current to flow only for one hundredth of a second. Any longer period would destroy the coil and connecting wires as thoroughly as a blast of dynamite and probably ruin the generator as well. Carefully measuring—by means of an oscillograph, which records by means of light rays—the current flow through various kinds of metal wire which are subjected to the tremendous magnetic field, Kapitza has upset established theories of electric current flow.

It has been known for a long time that a wire made of bismuth exhibits a peculiar increase in electrical resistance when placed close to a powerful magnet. Wires of other kinds of metal also show slight changes in resistance. When placed in the field of the world's most powerful magnet the resistance of bismuth wire increased nearly 2,000 times, an increase far in excess of that which had been calculated according to the latest theories of electron flow. Wires of other metals also give unexpected results.

BEEHIVES OR BATHTUBS FROM PALMETTO ROOTS

BEEHIVES, bathtubs, and garden furniture are now made from roots of the palmetto tree, a small palm of the southern United States. By grinding the palmetto roots and mixing them with cement of a special formula C. P. Wilhelm, of Punta Gorda, Florida, produces an extraordinary material which is said to be as light and as tough as wood, impervious to water, and as enduring as concrete. It has been demonstrated, moreover, to be practically unbreakable. Even tile flooring and roofing have been suggested as possible uses for the novel composition. The waterproof character of the material is shown by the fact that samples that were submerged in the Atlantic Ocean for eighteen months were unaffected by the immersion.

This unique material may be adapted to two handicraft processes. It may be cast as pottery or pressed from patterns. Garden furniture made with it is said to be only one fourth as heavy as the familiar cement article, and can be manufactured at one half the cost. The inventor is now turning out an order of 1,000 beehives, as well as supplying undertakers of four Florida counties with caskets made from the substance.

The supply of the basic material, palmetto roots, is practically unlimited, as there are thousands of acres of these trees in Florida. This is the first commercial use that has ever been found for the palmetto. Seven years of experimentation are behind the success that is now credited to the inventor.

Above, machines that peel the potatoes for canning and, below, the spuds in their tins.

PROCESS FOUND TO CAN NEW IRISH POTATOES

NEW potatoes can be served all the year round, through a canning process put into use a short time ago at a plant in Florida. Sweet potatoes have been put up in cans for some years, but the ordinary "spud" has never been canned on a commercial scale. In the new canning factory the small potatoes which farmers were formerly in the habit of throwing away are utilized. The potatoes are thoroughly cleaned of their skins by friction, and are then ready for consignment to the tins.

[illegible] furniture made at [illegible] by C. P. Wilhelm [illegible] palmetto roots. At [illegible] made cheaply.

RADIO SPEEDS UP PLANT GROWTH

[illegible] may possibly rely on a novel variety of fertilizer—radio waves. Successful cultivation [illegible] vegetables in one half the time ordinarily required through stimulation by radio has been reported by a German physicist, Dr. Fritz Hildebrandt. Exposing the seeds to extremely short radio waves of half a millimeter (about 1/50th of an inch) to thirty centimeters (about one foot) in length for fifteen minute periods, he asserts [illegible] able to decrease the ripening interval of tomatoes from seven [illegible] eight months to three months. Radish seeds, which had pro[illegible] growth within four weeks, matured within two weeks under the radio treatment. Kohlrabi, a sort of turniplike cabbage, also prospered. Encouraging results were obtained with other vegetables and plants, Doctor Hildebrandt said. The experiments were especially remarkable as they were carried out in poor soil.

NEW WELDING GAS MADE BY ELECTRICITY

A NEW gas called "electrolene," produced in a special electric machine, takes the place of hydrogen gas for welding torches and brazing furnaces. Made from steam and city gas, it costs only one tenth as much as hydrogen.

The machine that generates the new gas, developed by the General Electric Company, looks like a cylindrical boiler. Seven feet in diameter and ten feet high, it can produce 1,500 cubic feet an hour. One of these machines installed in a factory makes it unnecessary to purchase and store cylinders of gas.

Steam and city gas are automatically fed into the tanklike machine in proper proportions. Electric heat, controlled at any desired temperature, "cracks" or breaks down the ingredients to form the new gas. Thus the machine operates practically without attention. The resulting gas "electrolene," a mixture of hydrogen, carbon monoxide, and smaller amounts of other ingredients, burns at a higher flame temperature than hydrogen.

Here is what one camera got during the brief period of total eclipse at Camptonville, Calif.

MAKE TALKING MOVIE OF LATEST ECLIPSE

"TALKING MOVIES" recorded the latest [illegible] eclipse of the sun from an Army airplane over Claremont Field [illegible] Never before had the [illegible]

The [illegible] object [illegible] was to determine [illegible] could be done with [illegible] exact moment of each [illegible] eclipse. The "talkie" part of the standard sound film recorded time signals broadcast from the Mare Island Navy Yard, picked up on the plane's long-wave receiver. Through them, astronomers can measure the exact time of each picture within one fifth of a second. Then they will use the data to correct their predictions of the next eclipse.

Often an eclipse of the sun may be observed for a half minute or more, but this one gave astronomers only one and three fifths seconds to take pictures of the total phase. Consequently members of ground parties rehearsed their parts in advance. When the moment of totality arrived, they fed plates into the cameras with the rapidity of a gun crew.

MECHANICAL BAND MAY OUST ARMY MUSICIANS

F. TRUBEE DAVISON, Acting Secretary of War, recently authorized the Quartermaster General to procure for a service test "one mechanical substitute for an Army band."

The "mechanical substitute" is a three-quarter-ton truck which carries a phonograph and powerful amplifiers, developed by the Radio Corporation of America. Its martial airs are broadcast with such vigor as to be equal in volume to two large bands, according to the War Department. The quality of its music, moreover, is "approximately as good as that of the average service band," it is said. Though Army men may be taken [illegible] by the Star Spangled Banner coming [illegible] Army [illegible]

[illegible]

LIFEBOAT WITH DIESEL ENGINE DEFIES PANIC

A DIESEL or oil-burning motor, in a waterproof compartment, drives the latest "unsinkable" lifeboat. The new type of life-saving craft has been installed on the speedy transatlantic liner *Bremen*.

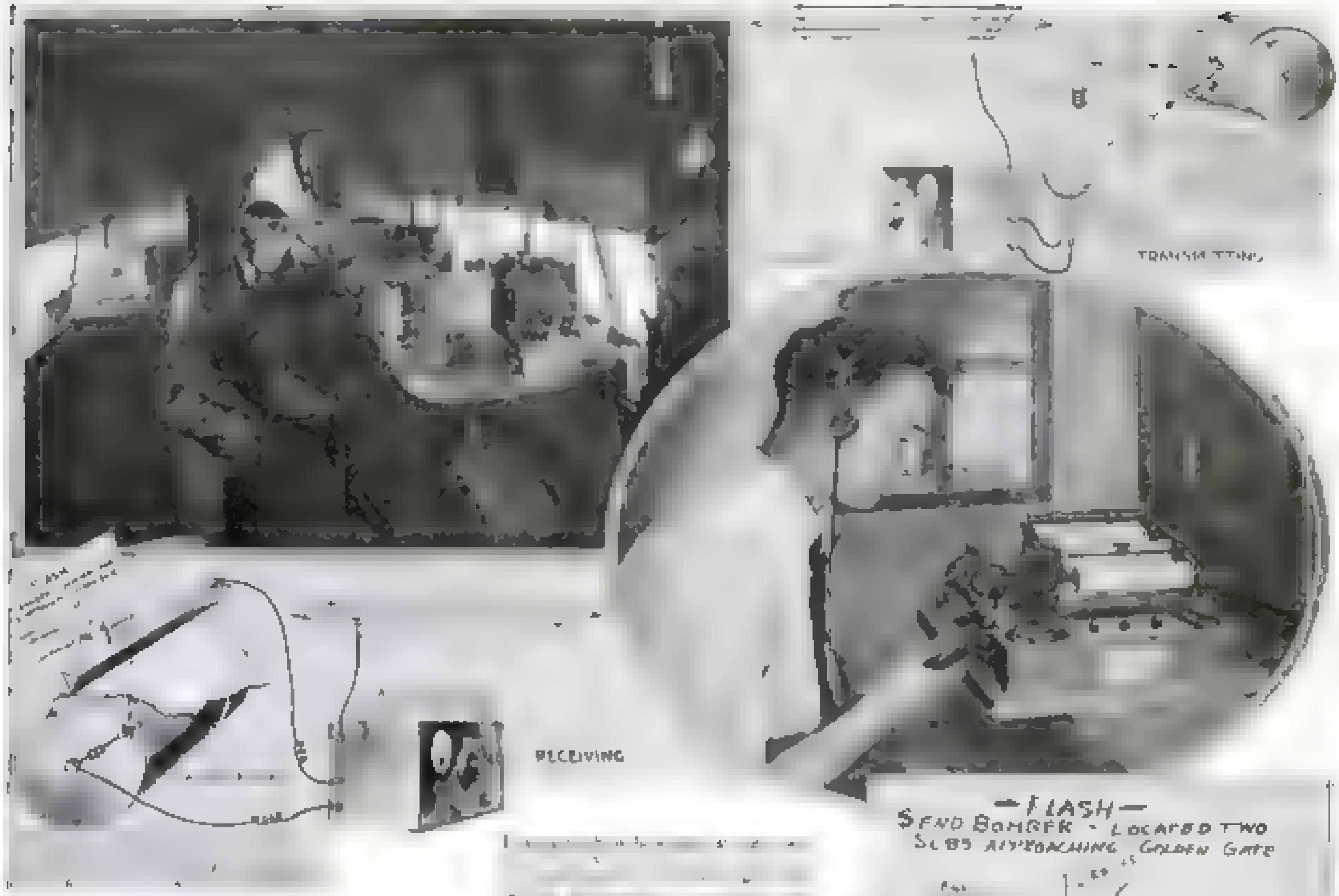
In a recent demonstration at a Brooklyn, N. Y., pier, 148 persons piled into one of the boats and it was lowered to the water. Then the occupants staged a mock panic, crowding first at the fore end and then at the stern, as excited victims of a sea disaster might conceivably do. Despite the unequal loading the boat shipped no water.

TENDERNESS OF MEAT GETS ACCURATE TEST

How tough is a piece of meat? One of the first instruments ever devised to test it accurately was recently installed at the United States Bureau of Standards, at Washington, D. C.

A metal disk mounted on a board between a blunt knife and a crank handle and attached by chains to both, records the force needed to draw the knife through a sample of meat by turning the crank handle. The entire apparatus, which is contained on one board, can be easily moved about.

The result of the tests may be that future generations will have a much better chance of getting juicy and easy carving meat every time they order from the butcher. Once the various factors in the life history of an animal which tend to make its meat tender are discovered, scientific experts may be able to use such information to breed animals that will be certain to pass on "tenderness" to their offspring.



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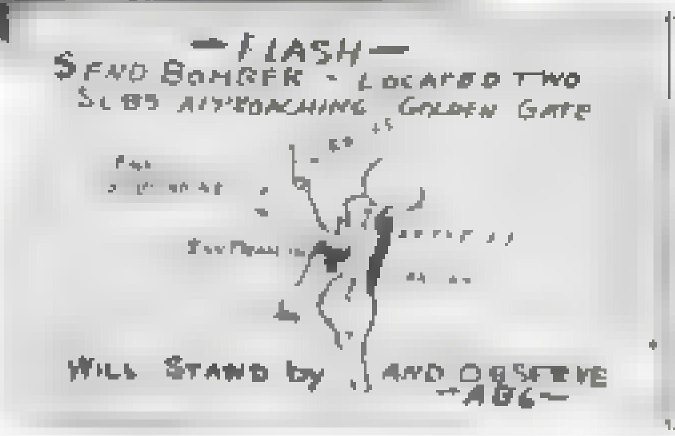


ARMY PLANE SENDS MAP BY RADIO

Two "enemy" submarines, approaching the Golden Gate apparently with the intention of destroying ships in San Francisco harbor, were sighted the other day by an Army transport plane. Five minutes later, Army men at Sacramento, eighty miles away, held in their hands a brown-and-white map revealing the submarine's position and bearing a recommendation that an air bomber be sent after the subs.

This was the first demonstration, during a mimic war game, of a new device that sends maps by radio from plane to ground. Observers in airplanes can furnish headquarters with sketches of enemy positions and routes of attack.

For the test, Lieut. Hayden P. Roberts, observer in the plane, drew the map with a soft lead pencil and placed it on a revolving cylinder. As shown in the simplified diagram above, an electric eye scanned it and converted its light and shade into radio impulses—a process resembling that by which photographs are transmitted by radio or wire.

At the receiving end, the picture was picked up in a new way by making electricity do the drawing. A blank sheet of special paper, soaked in a solution which made it a good conductor of electricity, moved over a second revolving cylinder. Electricity passed from a knife-edge on the cylinder through the paper to another knife-edge above, producing a brown spot or line on the finished drawing wherever the original copy bore a similar marking. In previous processes the image at the receiving end was registered with [illegible] paper. The [illegible] developed by engineers of the Westinghouse company.

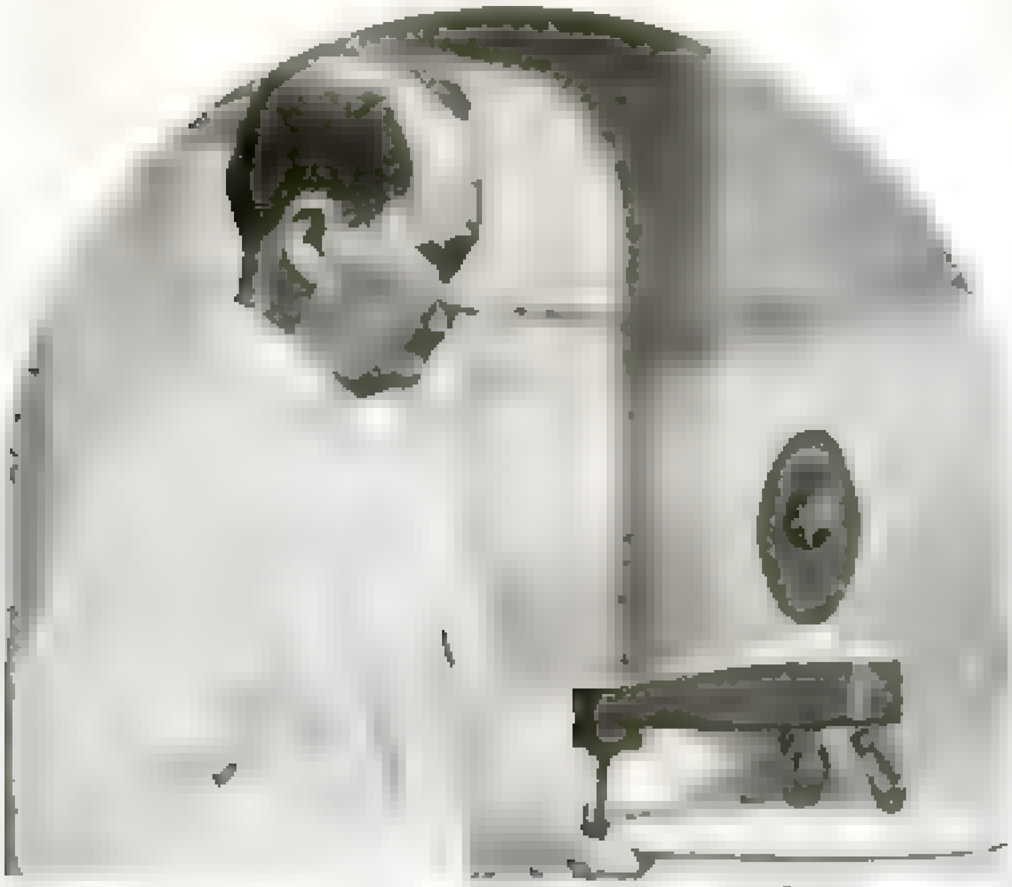
Amphibian planes slide up this saucerlike landing under their own power and discharge passengers.

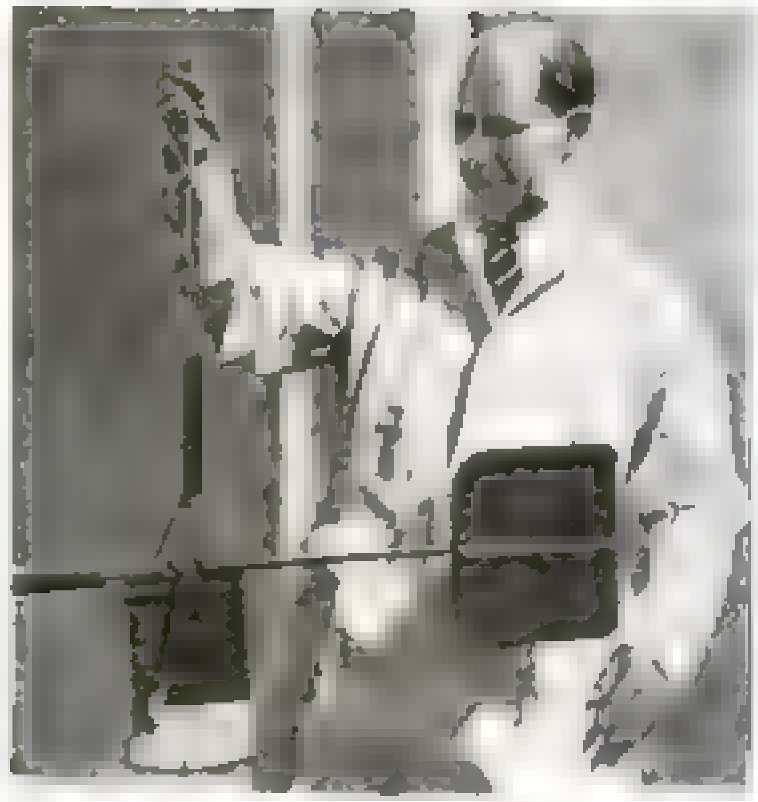
AMPHIBIANS CLIMB BUTTON LANDING

An "aquatic button," a sort of miniature seadrome shaped like a saucer cut in half and inverted, serves as a landing field for amphibian airplanes on the busy San Francisco water front.

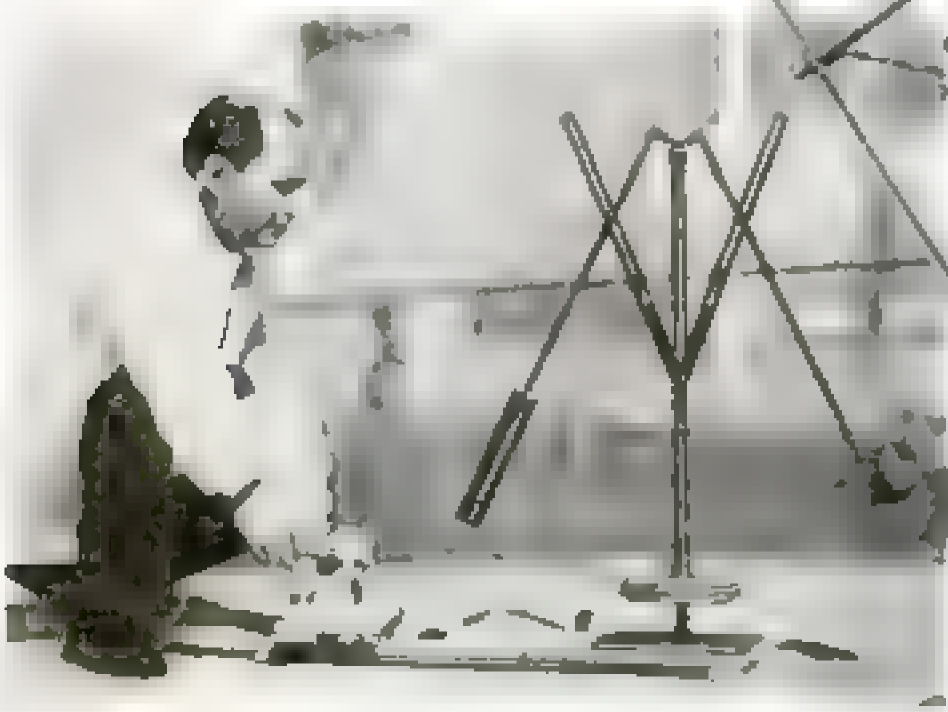
The device is a semicircular stage 100 feet in diameter, with sloping edges submerged. An amphibian easily climbs up the side of the button under its own power to discharge passengers. The float, ballasted to keep it from capsizing, is anchored against the tide.

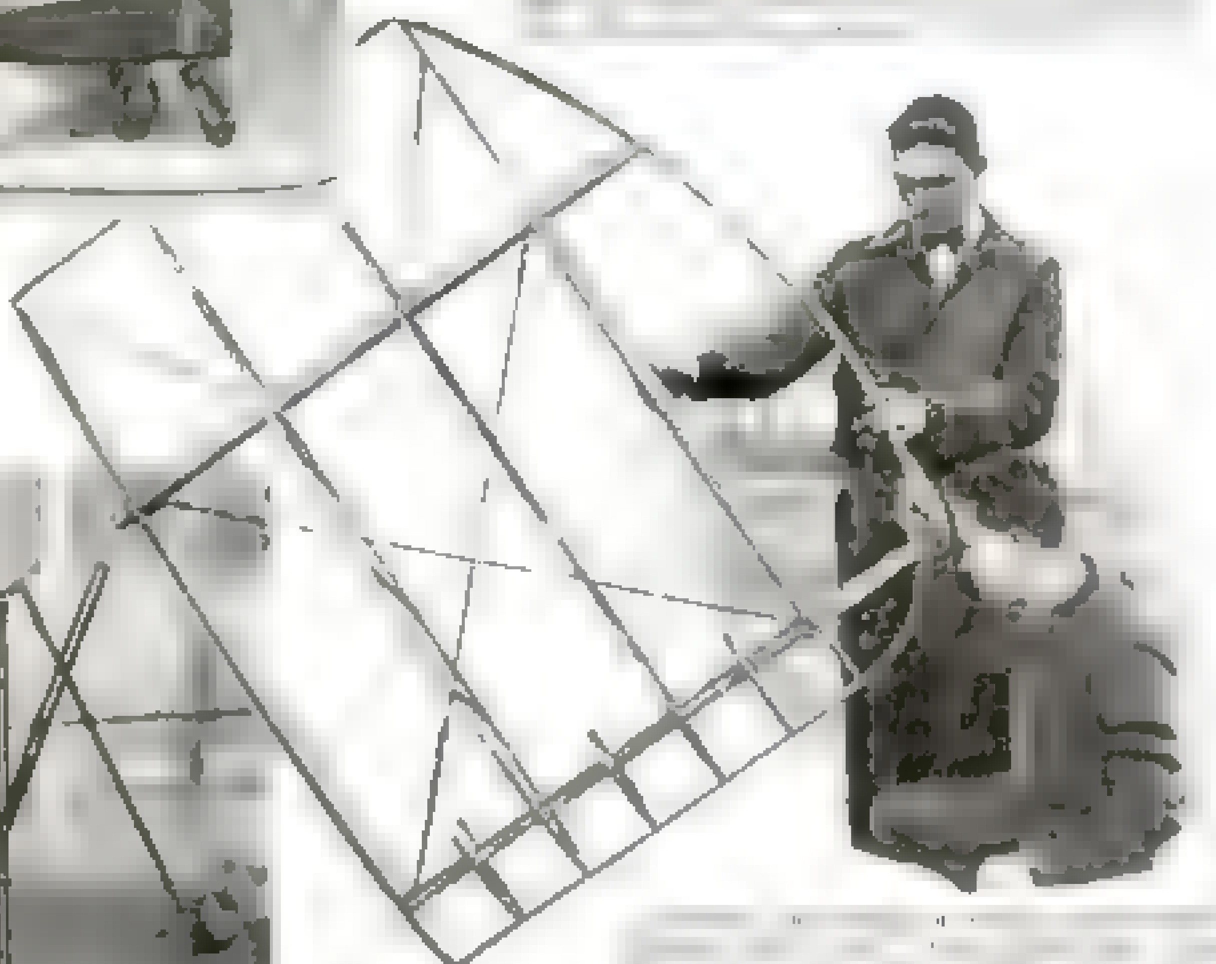
DEVICES FOR FLYERS INVENTED BY STUDENTS WHO CAN'T FLY





A model fuselage, shaped from a block of wood, is used to teach students to [illegible]





ONE test of a student's flying knowledge is his ability to build aviation instruments. So embryo pilots of the Boeing school of aeronautics, at Oakland, Calif., have constructed the devices pictured above while they are learning to fly on the ground.

A wind indicator for finding good gliding sites is a novelty that one student contrived. It looks like a weather vane, but it measures the strength of the up-drafts—necessary to support a flying glider—as well as the direction of the wind. Supported high in the air by box kites, it registers on a numbered scale the force of rising currents, which is read from the ground with the aid of field glasses. The rising air current pushes the flattened "tail" of the horizontal arm upward to give the reading.

Another student rigged up a turn and bank indicator, on an arm that is turned by a crank and cord, to help pupils familiarize themselves with its use before going up. A model of a fuselage and compass, for practice in setting the compass correctly due north, was a third invention.

PLANE FLIES MAIL FROM PARIS TO BUENOS AIRES

THE first transatlantic mail by airplane arrived in Brazil recently. It was brought by Jean Mermoz, French pilot, and two companions, who made the 2,000-mile water jump from Africa to South America in a seaplane flight of twenty hours. The flight was authorized by the French government as a test of the practicability of sending mail by plane, after Mermoz had proved his ability to lan[illegible]

This was the last link needed to complete direct air mail service between Paris, together with other European capitals, and Buenos Aires, Argentina.

An air mail line from Paris to Dakar on the west coast of Africa has been in operation since 1925. The same concern, the Compagnie Generale Aeropostale, established in 1927 an air mail line down the east coast of South America from Natal, Brazil, to Buenos Aires. It has connected the two lines with fast packet boats across the Atlantic and the record time for a letter's travel between Argentina and France was 178 hours. Of this time the despatch boats consumed 103 hours in crossing the Atlantic.

By flying the Atlantic, nonstop, Mermoz and his companions fulfilled the daring project of the company to operate the entire 8,000-mile route by air. Regular, scheduled service is expected to start soon.

FALLING LEAF STUNT IS DONE UPSIDE DOWN

Like a playing card falling from a sky scraper, Lieut. Alford J. Williams, crack naval pilot, fluttered to earth in an upside down plane the other day at Washington, D. C. Thus he performed a maneuver called the "inverted falling leaf," never tried before because it had been declared impossible to escape from it alive.

At home, with small models, Williams practiced until he felt sure he could perform the dare-devil feat. He soared aloft from the Anacostia naval air station in his fast Curtiss Hawk, its gasoline and oil tanks especially equipped for upside down flight. High above the field, he turned the plane over. The spectators gasped as it zigzagged crazily, tipping from side to side. Near the ground it straightened out for a perfect landing.

The feat was Lieutenant Williams' adieu to the Navy. He has resigned to devote his time to building a super speed plane, to win back from England the world's speed record in the air.

Diagram shows how the upside down falling leaf maneuver was demonstrated at Washington. The stunt, declared impossible, was done successfully.

A. J. Williams in farewell to the Navy, from which he has resigned, did an upside down falling leaf.

GLIDER, WITHOUT WINGS, SOARS ON FUSELAGE

Lester N. Yohe, college freshman and member of the Penn State Glider Club, at State College, Pa., set out to design a glider that would soar forward more than the conventional twenty feet while dropping one foot in the air. He built a model with a fuselage of concave bottom. The model could glide thirty-five feet for every one it descended. Then Yohe removed the wings. The glider still would fly, the fuselage acting like a wing.

Now the club is building a machine using the new fuselage, which Yohe has patented. It will have wings, but the novel fuselage will give it added range.

CRUDE OIL SMOKE GIVES PILOTS WIND DIRECTION

Smoke tells pilots the direction of the wind in a new invention for airports, which replaces the usual cone of fabric that swings from a pole. Burning crude oil, this new smoke pot can be run for only thirty cents daily. Installed in the center of the air field the stream of white smoke it pours out is visible two thousand feet in the air, revealing the wind direction and aiding pilots in landing. The first of the pots was tried out recently at a Los Angeles, Calif., airport.

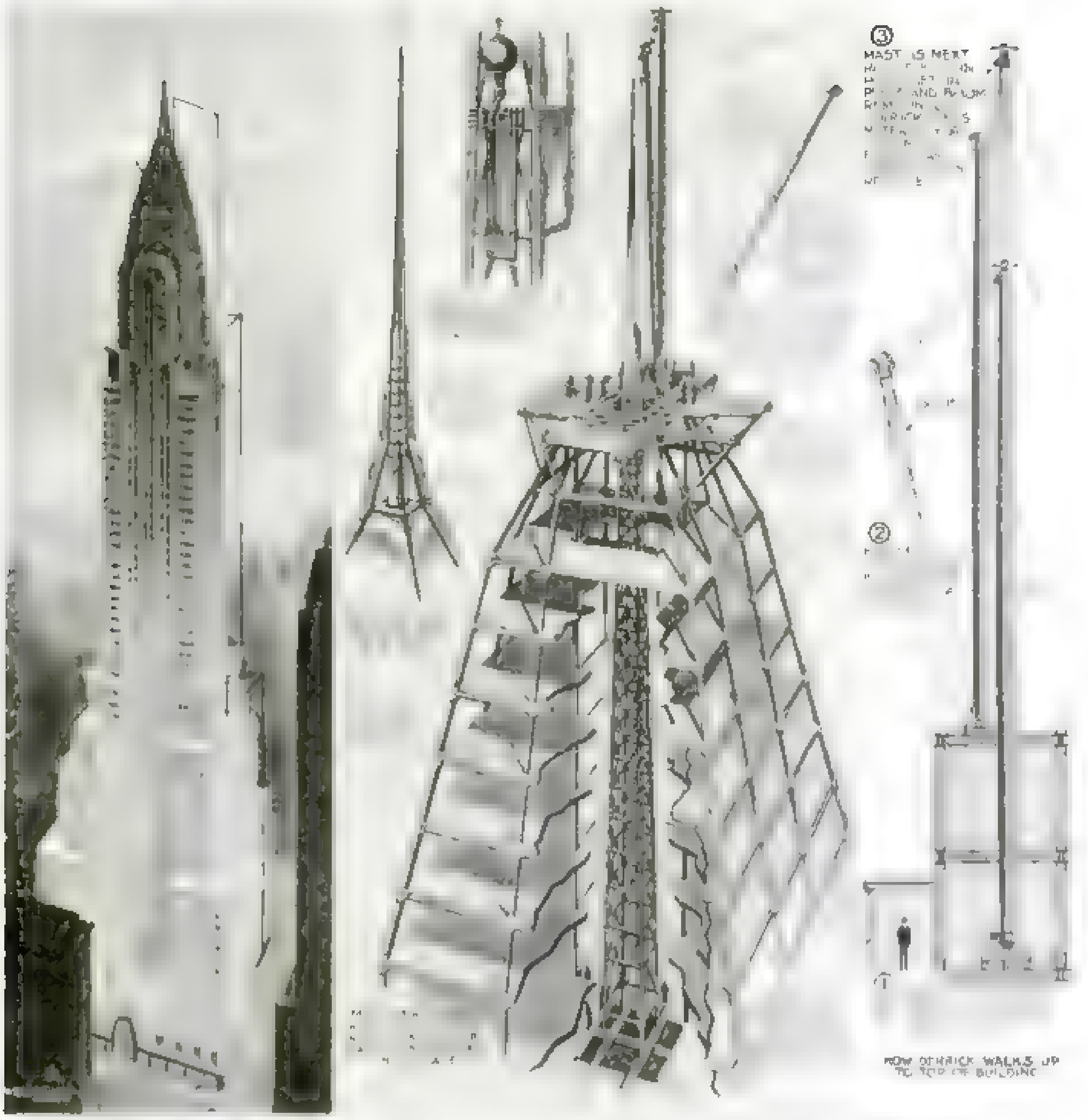
Watching the smoke pot send out its telltale smudge at a Los Angeles, Calif., airport. The drifting white plumes tell pilots, 2,000 feet in the air, in which direction the wind is blowing on the ground.

120 TO FLY IN GIANT PLANE

Now being designed in the Rumpler factory, at Berlin, is the largest airplane in the world. It will have a wing spread of 289 feet, or more than the length of a city block, and it will be 160 feet long.

Called a "flying wing," because passengers are carried within the hollow wings instead of in a fuselage, it will have a cruising radius of approximately 5,000 miles with a full passenger load of 120 persons aboard, and can carry a pay load of twenty-one tons.

Ten Diesel, or oil-burning, motors of 500 horsepower each will drive the super-plane. Construction of the aerial monster is expected to commence next year.



In this drawing the artist shows you how Chrysler Building spire was assembled inside structure and then raised by derrick. At left, black line indicates the levels from which derrick was used in hoisting sections of the spire. At right, how derrick was raised to top.

How Engineers Crowned World's Tallest Building

A SLENDER spire of rustless steel tops the 1,046-foot Chrysler Building, in New York City, which officially opened a few weeks ago. Many of those who see the shaft gleaming in the sunlight wonder how it was placed at the summit of the world's tallest building. On this page our artist shows how this task, one of the greatest of the many engineering feats in the erection of the building, was accomplished.

The spire, nearly two hundred feet long, was first built in sections by a bridge-building company.

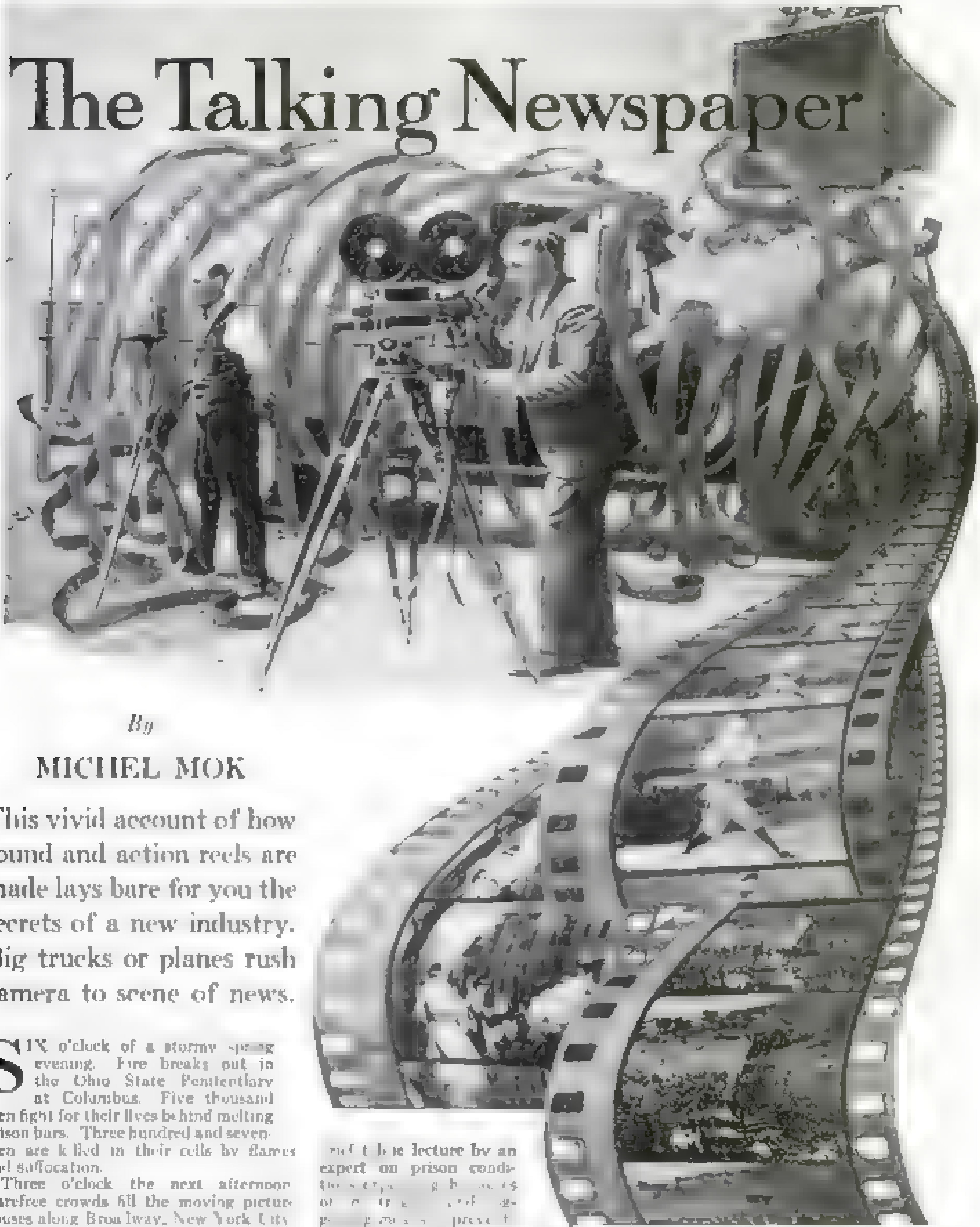
When the first section was delivered to the Chrysler Building, at street level, a derrick hoisted it to a set-back many stories high. Here it was seized from above by another derrick, and the process repeated until it reached the top of the building. Then it was lowered down a central shaft, or well, to the sixtieth floor and braced upon a temporary support of wooden beams.

The assembling of the spire took place in this well. The second section, hoisted to the top of the building and lowered down the shaft, was made fast to the first with rivets. In like manner, the last section was added and spliced on.

Finally the spire was complete. An eighty-five-foot derrick on top of the building grasped it by a special fitting riveted to its side, and the great spire rose slowly into place.

One question about the unique spire-raising feat remains to be answered: How did the derrick that lifted the spire get to the top of the building? The drawing at the right, above, shows how it was raised two stories at a time. Each time the steelwork of the building reached that height above it, the derrick was taken apart and its own boom used to raise the heavy main mast.

The Talking Newspaper



Dramatic events from all parts of the world are seen and heard as the sound camera makes its film. Above, Harry Harde at work.

By

MICHEL MOK

This vivid account of how sound and action reels are made lays bare for you the secrets of a new industry. Big trucks or planes rush camera to scene of news.

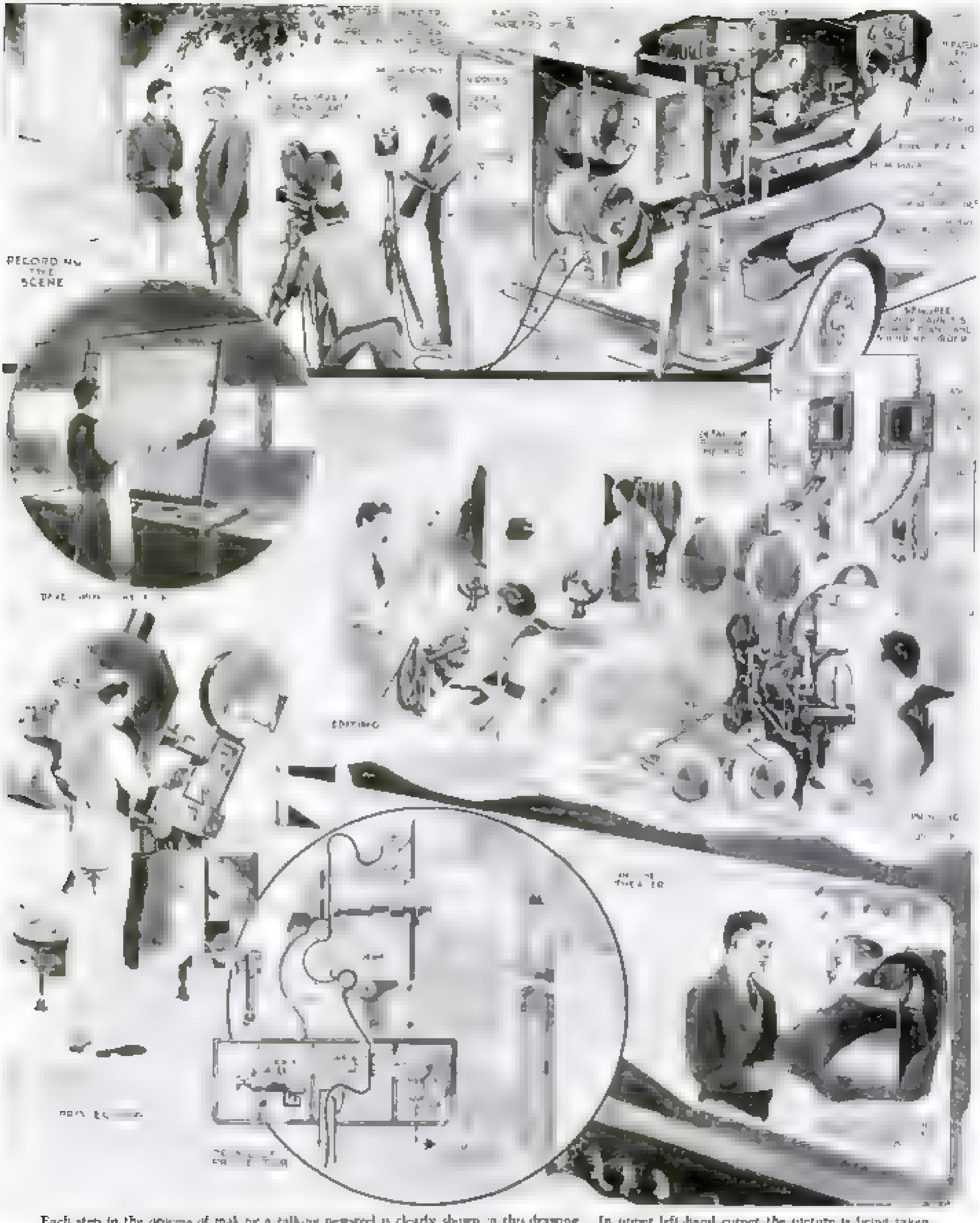
SIX o'clock of a stormy spring evening. Fire breaks out in the Ohio State Penitentiary at Columbus. Five thousand men fight for their lives behind melting prison bars. Three hundred and seventeen are killed in their cells by flames and suffocation.

Three o'clock the next afternoon. Carefree crowds fill the moving picture houses along Broadway, New York City. There, 600 miles from the scene of the holocaust, only twenty-one hours after the first alarm, Pathé News pictures of the disaster are thrown on the screens.

The theater patrons not only see the harrowing sights; they also hear the shrieking of the prison siren, the hissing as water hits flames, the howling of desperate prisoners, the crackling of burning logs, the thud of falling beams, the commands of Army officers and jail officials. More than that, they hear a [illegible] lecture by an expert on prison conditions [illegible] preventing its recurrence.

With this remarkable achievement, considered a world's record in the speedy gathering and presentation of audible photographic news, the sound newsreel some weeks ago came definitely into its own as a "talking newspaper." As a matter of fact, with the exception of a few "shots," transmitted by special wire, the pictorial story was in the theaters before the New York dailies had their pictures in print.

Sound news, a by-product of the talkies, is only a little over three years old. The first audible picture report of a news event was made on May 20, 1927, when Fox Movietone News recorded Lindbergh's historic take-off for Paris. A couple of days later, New York movie



Each step in the process of making a talking newsreel is clearly shown in this drawing. In upper left-hand corner the picture is being taken and the intermediate stages between that point and its projection on the screen, with the apparatus used, are presented in accurate detail.

audiences—sound equipment was still confined to New York theaters in those days—heard the roar of the motors of the *Spirit of St. Louis* as they watched the silver monoplane and its famous pilot rise above Roosevelt Field.

That same week a sound film of a West Point drill delighted thousands with the martial band music and the clicking of hundreds of heels that accompanied the rhythmic marching of the cadets. A fascinating touch of realism thus had been added to the "news."

These pictures were made by way of experiment. The first all-sound newsreel, also produced by Fox, was shown at the Roxy Theater, New York, in October, 1927. It included the Army-Yale football game in the Yale Bowl, rodeo performers, some other news events, and a few thundering shots of Niagara Falls for good measure.

Now the three-year-old has grown into an all-seeing, all-hearing giant that sprawls over the entire earth, catching any sight and sound that may interest, thrill, or amuse you, from Admiral Byrd's arrival, amid cheers, at New Zealand from Antarctica, and buzzing Army airplanes laying a smoke screen in a

sham air battle over California to the Prince of Wales's latest big-game hunt in Africa and the cooing prize-winner in a baby show at Wildwood, N. J.

A new United States Ambassador leaves for Turkey and tells what he means to do there. Aimee Semple McPherson, evangelist, returns from Paris and gives her impressions of that city. The baseball season opens in Washington, D.C., with President Hoover tossing out the first ball. Rin-Tin-Tin, barking lustily, performs for the children in a Buffalo, N. Y., orphanage. The Kentucky Derby is run at Churchill Downs, outboard motor boats race on the Hudson River. Mussolini decorates the air heroes of the Italian army.

These and a thousand and one other things, occurring in as many places, you may both see and hear at your favorite movie house around the corner. International events, national politics, the Army, Navy, aviation, and sports, the fields of exploration, science, and invention, the world of fashion and society are "covered" by the sound-news men. Interviews with celebrities, "human interest stories," and humorous features are thrown in to vary and lighten the news menu. Here, then, is a complete animated and talking newspaper.

Nowadays sound newsreels are issued regularly twice weekly by three companies—Fox, Pathé, and Paramount, and shown in about 12,000 theaters throughout the country. In New York, in the heart of the amusement district, sound news has a home of its own, the Newsreel Theater. Here nothing but sound news is presented in hourly shows from ten o'clock in the morning until midnight. While the basic program is changed only once a week, "spot news" is shown as it develops. In other words, the latest sound-news flashes, rushed to New York from all parts of the country and sometimes from the ends of the earth, are inserted constantly into the films. Since it opened last November, the theater has been crowded at every performance.

One of the reasons for the success of this undertaking, and of sound newsreels wherever they are shown, is the speed with which the pictures are screened after the events occur. Sound news, of course, must be hot off the griddle. A stale news film is just about as interesting as the [illegible] of Thursday before last.

A [illegible] truck making a film in the yard of the penitentiary on Welfare Island, East River, New York, of [illegible]

One of the big $25,000 trucks used to carry the sound film apparatus is here being hoisted on board an ocean steamer for transportation to the Old World

To insure the swiftest possible service, the three news movie companies have built up elaborate organizations. In every important city in the United States, and at strategic points in virtually every foreign country, they have their representatives—trained men with a keen sense of news and a thorough understanding of what interests the American public.

Every fast means of transportation—the swiftest steamers, express trains, airplanes, and high-powered automobiles—is brought into play to rush the films to the home plants in and near New York City, where all negatives are developed, and later to distribute the finished product to the theaters.

The foundations for their world-wide organizations were laid by the companies in the old "silent" days. But the advent of sound has revolutionized the business. Until three years ago, gathering pictorial news was a solo job. All that was necessary to make news movies was one experienced man, a camera, a tripod, and a loaded film magazine. The camera man's equipment in those days never weighed more than a hundred pounds.

Sound recording, however, involves the use of a good deal of elaborate machinery. A miniature talkie studio has to be taken to the spot where the news "breaks," and it must be taken there quickly. The solution of this problem is the sound truck which, in effect, is a small, outdoor sound studio on wheels. When you see and hear a sound news picture, no matter where it was taken, you may be sure, in nine cases out of ten, that a sound truck was near

Into the den of wild beasts goes the talkie camera man to give you sound movies of these creatures. Here the king of them all is getting his looks and roar recorded.

Continued on page 116

Splicing a Cable in Mid-Atlantic

[illegible]

The author of this article went as a member of the crew of the cable ship in order to get this vivid, first-hand story for you.

By BURT M. McCONNELL

Photos by Author

TORN and twisted, an ocean cable last winter lay buried under a layer of clay two miles beneath the gray-green, foam-capped waves of the Atlantic, three hundred miles east of Halifax. It was shattered by the terrific earthquake that shook the Atlantic seaboard for a distance of 1,000 miles and put out of commission about half of the underwater communications between the United States and Europe.

In New York and London, cable executives and engineers held hurried conferences; sent out urgent wireless messages to their cable-repair ships in various parts of the world. For years I had been wondering how a broken cable was fished out of mid-ocean and spliced. Here, at last, was my chance to see the job done. I shipped as a member of the crew aboard the *John W. Mackay*, the Commercial Cable Company's vessel, commanded by Captain Livingston.

Luck was with me. Of the eight repair ships called to the scene from points as far away as Panama and London, our boat was the first to reach the earthquake's epicenter, the point on the ocean floor directly above the origin of the disturbance.

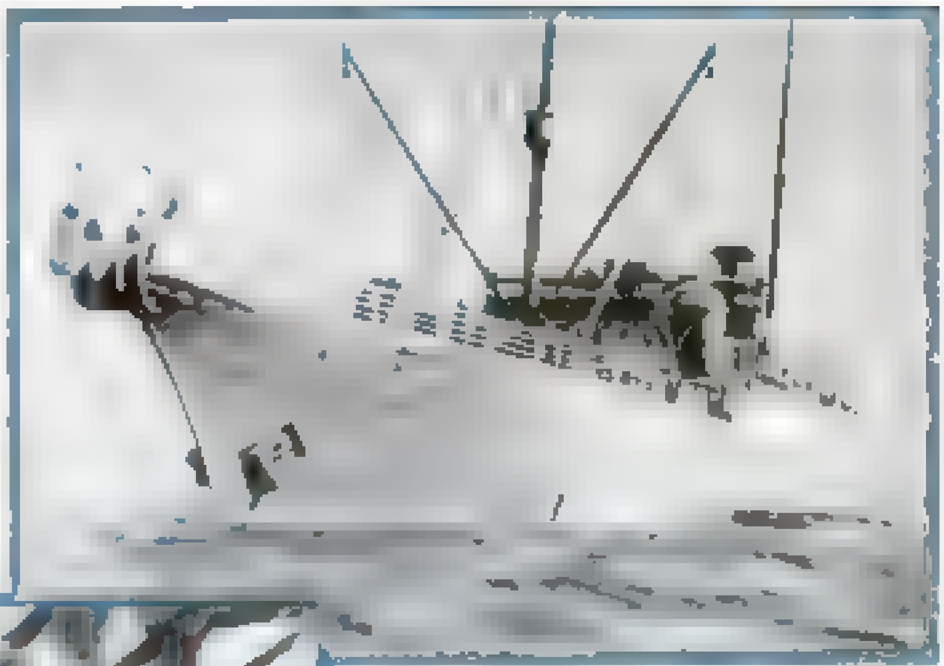
The location of the break was determined to within a couple of miles by delicate electrical devices in New York and Newfoundland cable offices. This they did by measuring the resistance and the capacity of the broken sections, the quantity of electricity they were capable of holding, and comparing them with the known capacity and resistance of the cable before it was broken. The exact latitude and longitude was then sent by radio to the cable repair ship.

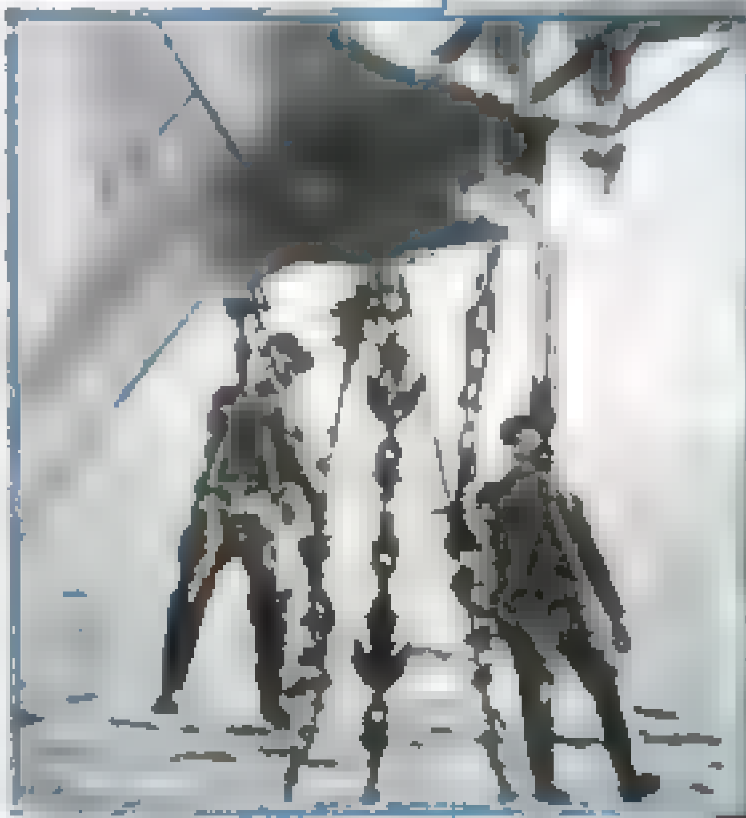
Captain Livingston has been picking up broken cables from the Atlantic and Pacific Oceans for twenty-two years, and he knows the value of time in such an emergency. Full speed ahead he drove

Reeling in the broken cable. The grinding winches work for hours while the cable rises slowly from the bottom of the sea. In the bow, at upper left, stands Captain Livingston, watching the ticklish job.

the *John W. Mackay* from the Bay of Fundy to the Grand Banks. Thirty miles from the earthquake's epicenter, he and his navigating officer shot the sun and compared results. On the bridge, the officer on watch was getting the depth with a sonic depth-finder, the apparatus that sends sound impulses into the water so that they strike the bottom and are caught, as it were, on the rebound. The depth is measured from the length of time it takes for the echo to return to the surface.

On the deck below, others were sounding with the time-honored lead and obtaining a sample of the bottom. The lead checked with the sonic depth finder, and the sextant observations checked with the chart and the soundings. So far, so good, we were within four miles of the cable. But the sample of the bottom was not so reassuring. Instead of slimy, black mud, which they always had found at this spot, it was dark-brown clay! Had the earthquake changed the bed of the Atlantic to such an extent? Or had a landslide of unheard proportions occurred, burying the cable?





Lashing a buoy to the shrouds. This buoy is used to mark location when a heavy fog blots out the sun

WE WERE directly over the westerly edge of the great submarine trough that runs from the mouth of the St. Lawrence River out into the Atlantic. Skippers of liners and Newfoundland fishing boats said "the ocean bed had dropped away"; that they were no longer able to reach bottom with their sounding lines. Plainly there was some exaggeration in this statement, for Captain Livingston found bottom at 1,650 fathoms, the same figure that appeared on the chart. And right above the epicenter, at that!

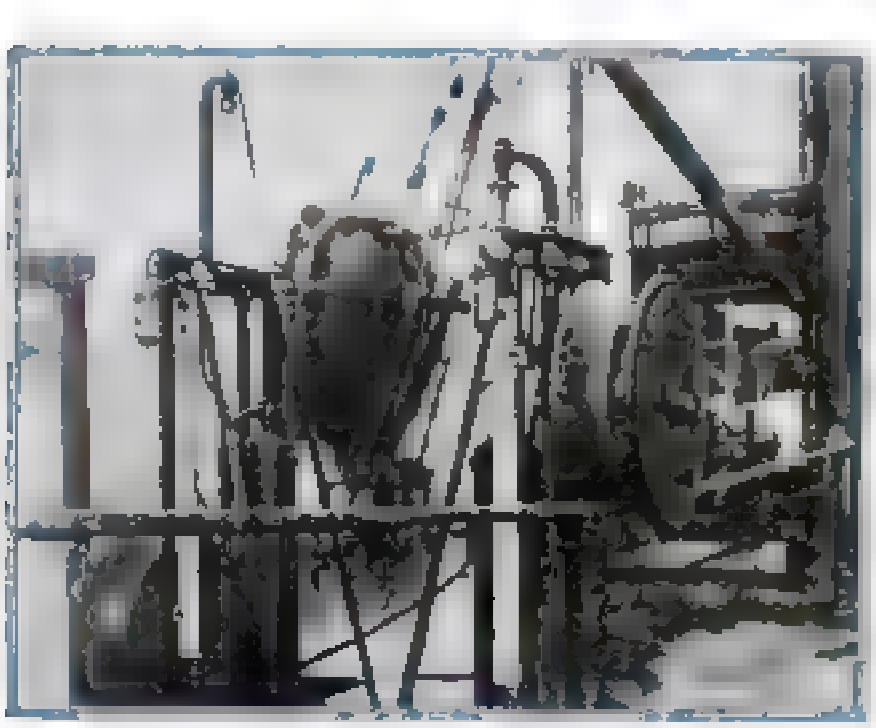
A dense fog slowly enveloped the cable ship. No further observations were possible. But a mark buoy had been put over the side and anchored to the bottom. This buoy was six feet in diameter and capable of sustaining two and a half tons. It was picked up when the weather cleared, meanwhile, "drives" were made with the buoy as a guide.

Up in the bow, a group of sailors were tossing what looked like a huge iron flat fish with reversed hooks to a clanking chain. This in turn was fastened to a jute-covered steel cable-rope, which was wound on drums below. As spray freezes quickly on deck in winter, much of a cable ship's machinery is in the hold.

On the tip of the forward deck, where any ordinary ship would have her bowsprit, the *John W. Mackay* has three huge sheaves. Over one of these immense pulleys runs the grapnel rope. Fifty feet aft it runs over and under dynamometer pulleys. It is the dynamometer which registers the strain on the cable-rope. When the indicator points to 2,200 pounds, the captain may be sure that he has a "bite," that he has hooked the cable.

Shortly after two o'clock, the fog lifted and the ship was at right angles to the broken cable and four miles distant. On the bridge Captain Livingston was giving the course to the officer on watch. The exact position of the vessel was marked on the chart. Then the Captain stepped down to the main deck.

"Throw her over!" he shouted, and the 300-pound grapnel fell with a *plop* into the gray-green depths. While the "flat fish" sank to the bottom, the ship remained practically stationary. Then the engines were turned over slowly, and the *John W. Mackay* drove ahead at less than a mile an hour—greater speed might have caused the "flat-fish" to skip over the submerged cable.



This dynamometer shows a strain of about 2,400 pounds when the grapnel hook catches the cable. That is the signal to start reeling in.

SOON the trailing line, with the huge hook at the end, was describing an arc, with the "flat fish" itself dragging a mile astern of the ship.

The dynamometer began to register a slight strain, indicating that the grapnel was on the bottom, which was rather soft. There were now about 2,650 fathoms of cable-rope over the bow, and the Captain stopped paying out. The deck crew lined the rail; they were the pick of Newfoundland and Nova Scotia fishermen—good boatmen and deck hands, and they found fishing for cable fully as fascinating as fishing for fish, and more profitable. Even the skipper, who had watched thousands of grapnels go overboard, found the game as intriguing as ever. He had been on the job thirty-six hours, without sleep; but that was not at all unusual.

It was time for a new watch, and while a group of fresh (Continued on page 108)

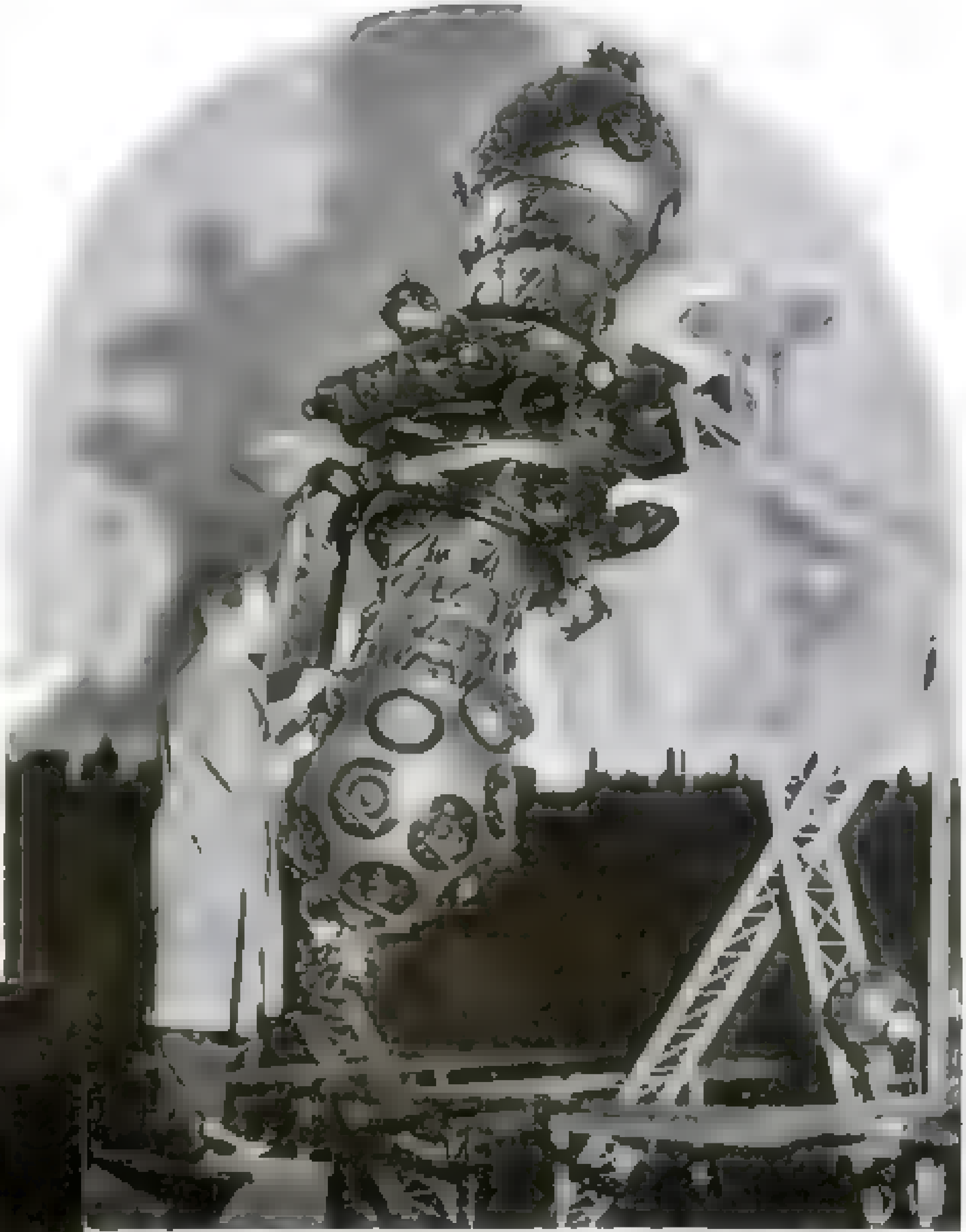
Universe Whirls on Plaster Sky

AMERICA'S only planetarium, a million-dollar project, was opened recently on an artificial island in Lake Michigan just outside Chicago.

A planetarium is a building in which points of light, representing stars and planets, are projected against a dome by means of illuminated stereoptican slides to show spectators the movements of the heavenly bodies. This is accomplished by a huge, scientifically accurate projection machine. The instrument contains 119 lenses and the same number of small projectors. By manipulation of electric switches, these project 5,400 images of stars and planets against the white ceiling of the building, as they appear in their proper positions.

Thirty-two of the small projectors throw images of the stars; eighteen show nebulae and star clusters; two, the Milky Way, thirty-two print the names of the stars and their constellations in light against the dome while there are special devices for the planets of the solar system.

Dr. Philip Fox, director of the planetarium and former professor of astronomy at Northwestern University, lectures on the stars and talks to five hundred spectators in the auditorium as he operates the instrument from an intricately constructed switchboard. He also holds in his hand an electric flashlight, a miniature projector, which throws an arrow pointer against any star's position to which he wishes to call attention.



Giant projector which throws 5,400 star images upon the white dome. Paul Lang, technician of the planetarium, was brought from Germany to erect this instrument.

Above, Dr. Philip Fox, director of the new planetarium, is turning his flashlight pointer at the stars. Left, the new planetarium building erected on an artificial island in Lake Michigan, with part of dome cut out to show the room across ceiling of which the sun and stars march.

Dr. Fox is inspecting the dumb-bell shaped projector which is used in flashing celestial images on the dome. The projector was made at the cost of $90,000.

POPULAR SCIENCE SCRAPBOOK

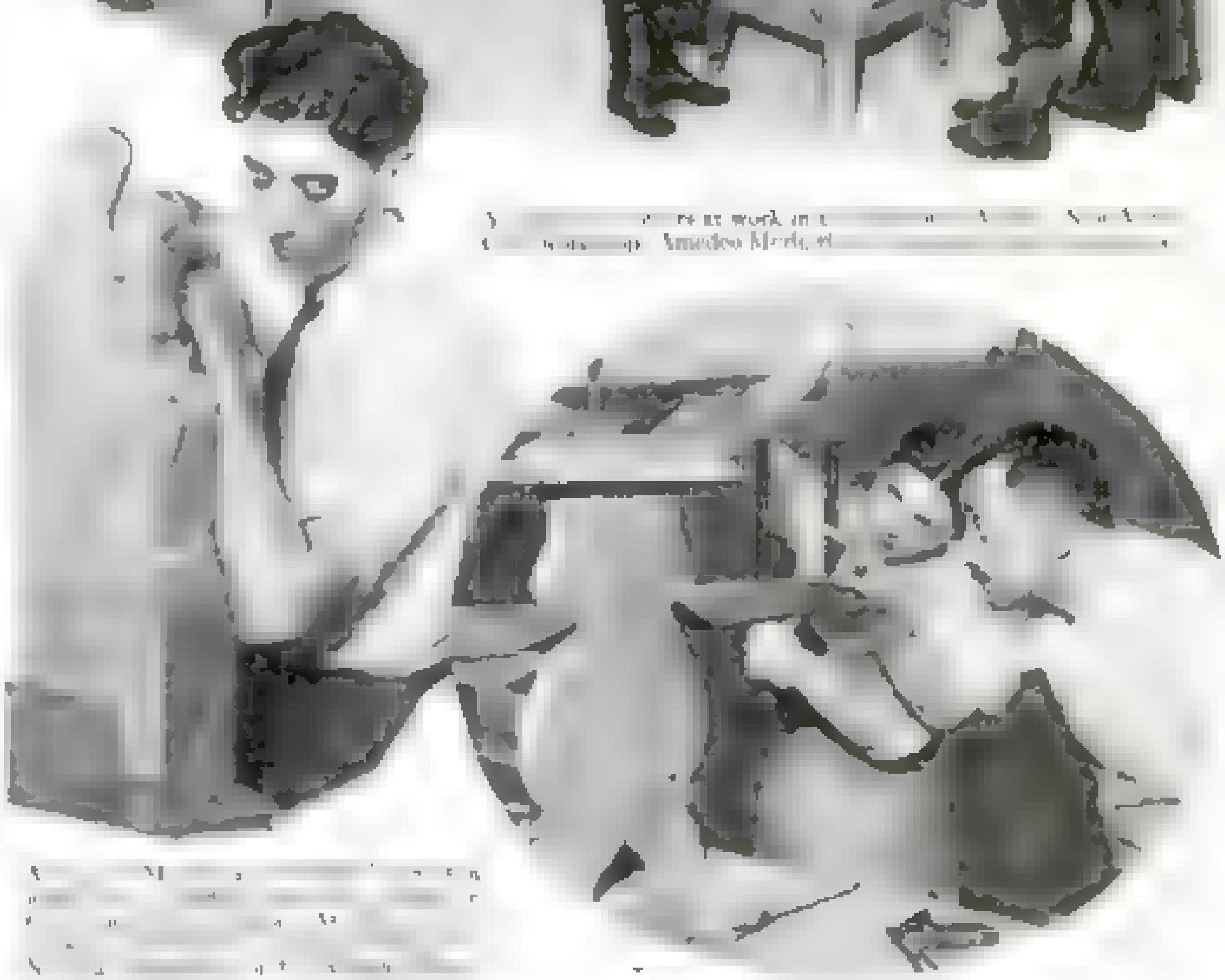
News, pictures, and brief bits about unusual people, places, and things from all parts of the world are shown on the following pages

NEW YORK HAS THE ONLY SCHOOL FOR STONE CUTTERS

A STONE-CUTTING school, said to be the only one of its kind in the country, is supported by prominent society people in the famous artisans' center of Greenwich Village, New York City, for instructing talented children. Like young apprentices in the care of the sculptors who carved the stonework of the great medieval cathedrals, these ambitious children receive routine drill in the technical mysteries of sculpturing stone.

Woodcarving, cabinet-making, and ironwork are also taught. When the pupils reach the age of eighteen, if they have given proof of their skill, jobs are procured for them.

[illegible] at work in [illegible] Amedeo [illegible]



BITTER MEDICINES HIDDEN IN FOOD

SWALLOWING bitter medicines may be made less unpleasant by taking them in the guise of sea foods and other dishes, suggests Dr. Rene Loubatie, of Bordeaux, France. As an example he cites the inoculation of oysters with iodine, the chemical element that is vital to the activity of the thyroid gland. Most sea foods contain some iodine, but often a doctor wishes to give his patient slightly more iodine than the natural foods contain. By a deft piece of surgery, Dr. Loubatie can open the shells of oysters and by the exercise of skill and care he can prevent the possibility of germs getting in. He then soaks the oysters for a few minutes in a solution of iodine until they have absorbed an abnormal amount of the chemical. Next he washes the oysters in fresh sea water to restore their flavor. Enough iodine is retained in the oysters to make them acceptable "thyroid" medicine, and the disagreeable side of taking the required dose is eliminated—if you like oysters.

Dr. Loubatie believes that the value of many medicines is destroyed by their unpleasant taste, which upsets the stomach. Hence he recommends the new medical art of "therapeutic gastronomy," which should conceal iron in omelets, secrete castor oil in salads, and perform other feats of kitchen magic in coaxing patients to take noxious medicines.

SIPPED BOOZE GIVES A SWIFTER KICK

EXPERIMENTS have convinced a Spanish physician that wines and other liquors give a greater "jag" when sipped slowly. Dr. Jose Calleyaz, of Madrid, searching for the best way of giving stimulants to patients in a state of collapse, found that if he administered the alcohol drop by drop into the patient's mouth, he got prompt effects. Continuing his investigations he discovered that wines and beers give more spirited action when taken in the "drop by drop" manner.

Dr. Calleyaz states that the rapid effects obtained are due to the warming of the liquor by the throat. American doctors, though, say that it is due rather to the fact that the mouth and throat linings absorb alcohol into the blood more quickly than do the linings of the stomach. The "sipping" habit is becoming popular among Spanish workmen and peasants, according to reports.

POPULAR SCIENCE MONTHLY is always pleased to answer questions on any subject within its field, if readers will address their inquiries to the Information Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, inclosing a stamped, self-addressed envelope for reply.

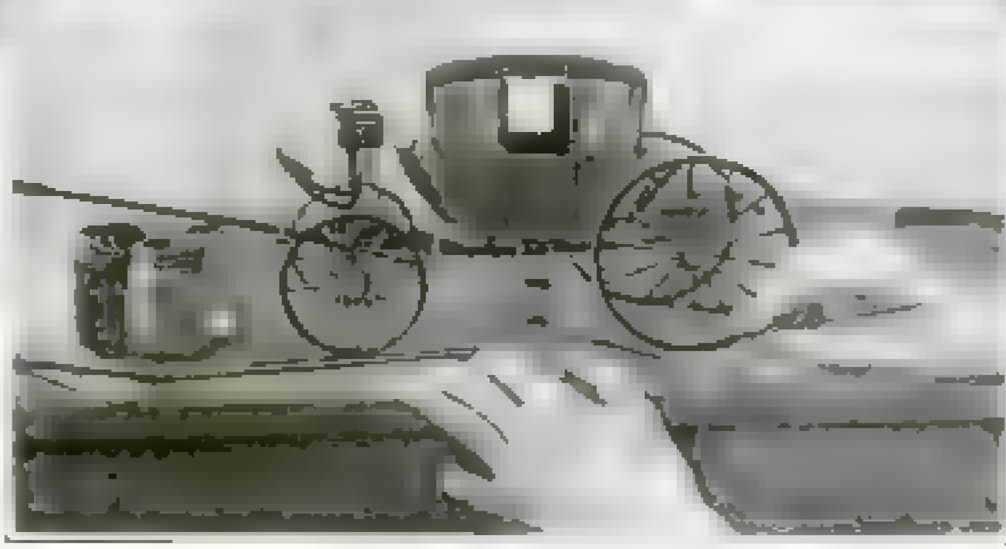
Historic Scenes Shown in Fine Models

News and events of long ago re-created in miniature by master craftsmen for Museum of the City of New York. Details, faithfully reproduced, give clear vision of the days of long ago

Wax is poured into this mold by [illegible] and out of it will come a horse [illegible] into the group that forms the famous Blue Bell Tavern scene which will be shown at the City Museum of New York when it opens its new home on Fifth Avenue [illegible]

When New York Was New [illegible]

[illegible] of New York [illegible]



[illegible] drawn [illegible] work on the part was begun [illegible] reproductions [illegible] the gaudy and elaborate [illegible] that once rolled [illegible] of New York's Fifth Avenue

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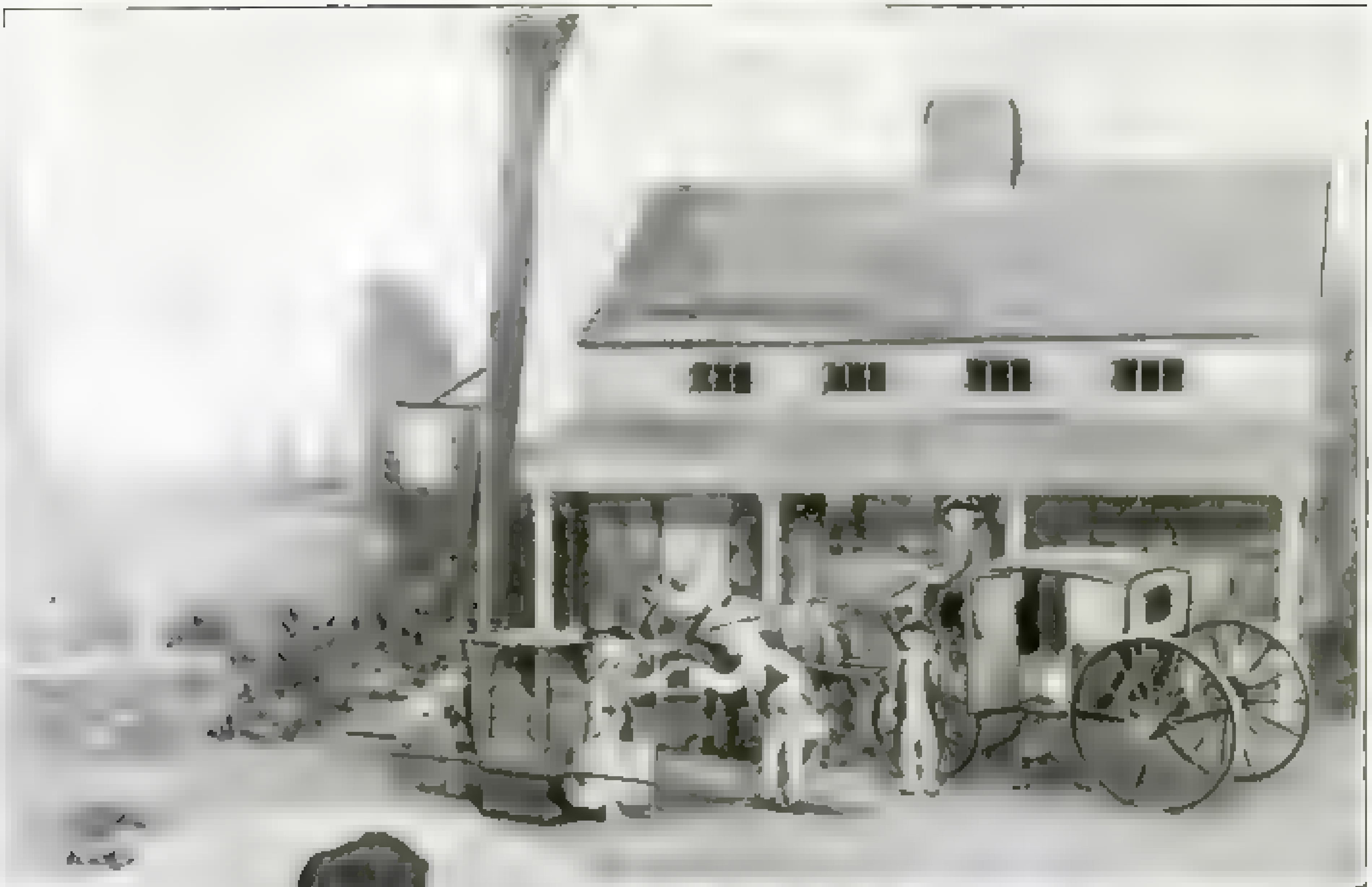

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All of the models for the City Museum group are made on a scale of one inch to one foot. Hence the various human figures are from five to six inches in height, but great pains are taken with the details

In the days when transportation was simple and traffic laws were unheard of. These oxen were brought from Holland, and studies of old prints were made to be sure that exactly the right breed and coloring were modeled for the City Museum exhibition.

[illegible] de view of the *Enterprise* mast in [illegible] Note the iron clamps [illegible] glue dries, and also the [illegible]

[illegible]

MASTS PLAY BIG PART IN AMERICA'S EFFORT TO DEFEND YACHT CUP

When builders were ca[illegible] America's four cup defender yachts w[illegible] taller masts than ever seen before, the[illegible] solved a problem unique in marine de[illegible]sign.

These boats, of which the fleetest one will defend the famous America's cup against Sir Thomas Lipton's *Shamrock V* next September, will all have spars more than 160 feet high (P. S. M., July '30, p. 61). How the enormous masts were made has just been revealed in detail. They are not, like those of old, hewn from one great tree, but are composites.

The masts for the *Weetamoe* and the *Enterprise* (the latter subsequently replaced with a spar of metal) were built at the Nevins Shipyard, City Island, N. Y., of straight grained spruce. The pieces, carefully machine planed, were spliced together with a long taper or scarf joint, the fit of which is made by planing the joint by hand, so as to obtain perfect contact for gluing. It took about ten pieces spliced together to make the necessary length.

The building up of the mast was done in four separate operations. Two separate quarters were glued together and after the glue had set, the inside was shaped out concave. The two separate quarter sections were then glued together, making the half of the mast. In like manner the other half was prepared and then the two halves were glued together.

The finest quality of casein joint glue was used. It was applied cold with brushes, and the various pieces were held together under pressure by the use of iron quick-action clamps until the glue set. The clamps were spaced about ten inches apart. A dozen men were needed to spread the glue. The casein glue used is made from the curd of milk and is waterproof.

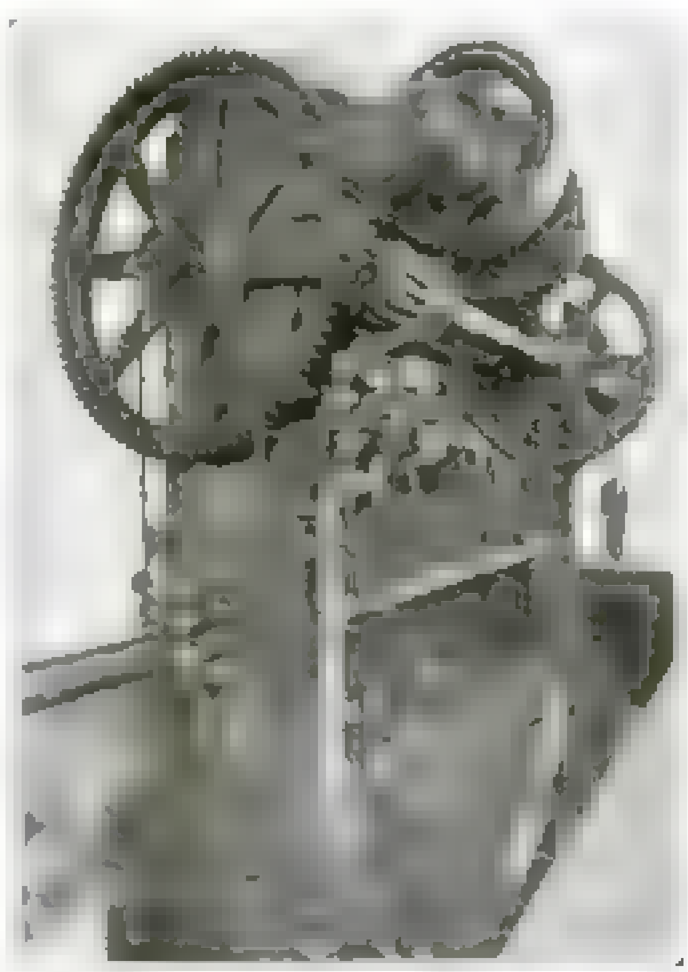
The second method of construction, that used in making masts for the *Yankee* and *Whirlwind*, is entirely different. Each mast consists of eight sections with separate pieces. From 400 to 500 pieces are glued together for each mast.

The straight members were first glued up, then resawed and the joints staggered and glued again, in like manner the curved [illegible] were built up. Thirty to [illegible] were needed to spread the glue and apply the chain cl[illegible].

A novelty in mast construction was the second spar fitted to the *Enterprise*, a shaft of duralumin, which was to be tested at this writing.

End view of *Enterprise* mast before it was trimmed down true. In this photo the arrangement of the pieces is clearly shown

36-FOOT PRESS MAKES TRUCK FRAMES



Truck frame press, biggest of its kind in the world, is 36 feet high and weighs 800,000 pounds

Six men, each six feet tall, standing on top of each other would only just reach from the floor to the top of a gigantic press recently completed at a mid-western plant for stamping the frames of auto trucks.

The slightest turn of the huge wheels that work the mechanical monster causes a pressure of 3,500,000 pounds, the weight of a large freight locomotive, to be exerted at the bottom. The clutch mechanism for throwing the press into gear is controlled by an air valve which a three-year-old child could operate.

RADIO MAKES STATE ONE POLICE STATION

Soon the State of Michigan will open a high-power radio station to help police catch crooks. Authority for the 5,000-watt installation at Lansing, Mich., has just been granted by the Federal Radio Commission.

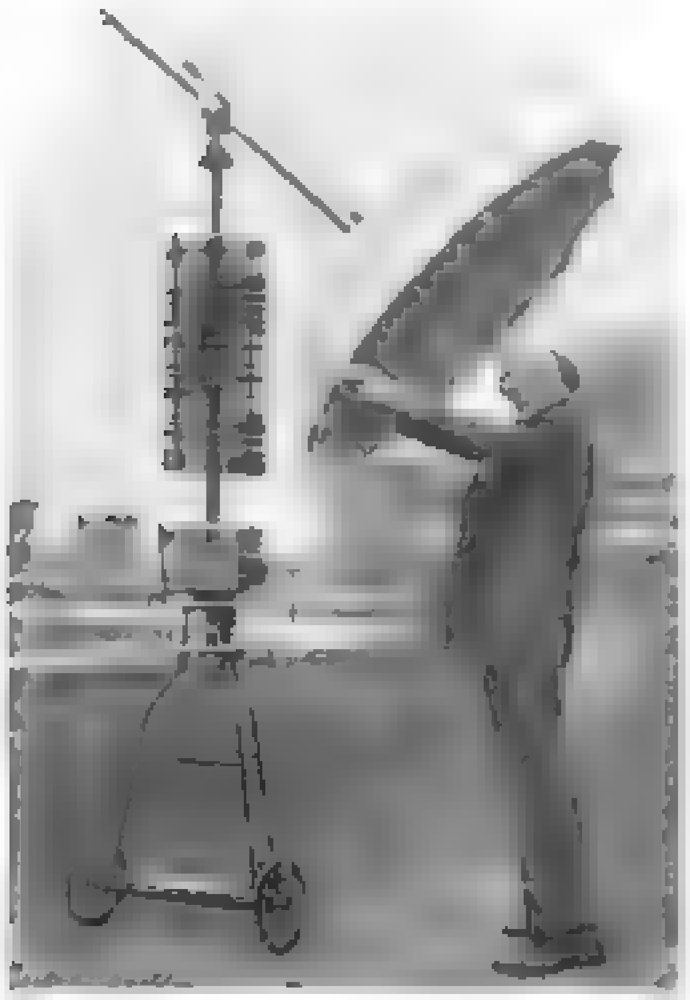
State patrol automobiles carrying radios will be able to pick up the station from any point in the state.

PLANETS ON UMBRELLA MAKE ASTRONOMY EASY

A NEW invention for amateur astronomers is said to make self-instruction in the secrets of the skies easy and absorbing. It is a homemade planetarium, which reproduces in miniature the dome of the heavens, showing the planets and constellations mapped out in their proper positions.

The unique contrivance was constructed by a New York City inventor from simple frame parts of metal and wood, while an old umbrella hood served for a dome. It rests on wheels so that it can be moved about without difficulty.

Attached to the frame is a series of bar magnets placed in line with the wooden strut which supports the umbrella dome. If the device is held off the ground by a string, these magnets swing the frame so that the center point of the dome points directly at the North Star. The astronomer in this way obtains his bearings, and



With his homemade planetarium, Clement Engel New York inventor makes study of astronomy easy

is ready to study the stars by verifying their positions according to the carefully labeled map on the inner surface of the umbrella dome.

USES PERISCOPE IN SKETCHING FISH

THE haunts of the marine underworld are an open book to Dorothy Beck, an amateur artist from Livermore, California, who is sketching as many scenes of sea life as possible during her round-the-world trip. She has merely to place her big wooden periscope in the water in order to bring before her eyes a moving picture of activities of marine life. Her intention is to have upon her return to the United States a unique collection of pictures, showing the life of exotic fish that make their home in strange corners of the globe.

The picture shows Miss Beck, with her native guide and assistant, sketching the fish found in the tide waters along the shores of the island of Ceylon. She is making her sketches as nearly accurate as possible for the purpose of adding to their scientific, rather than their artistic, value.

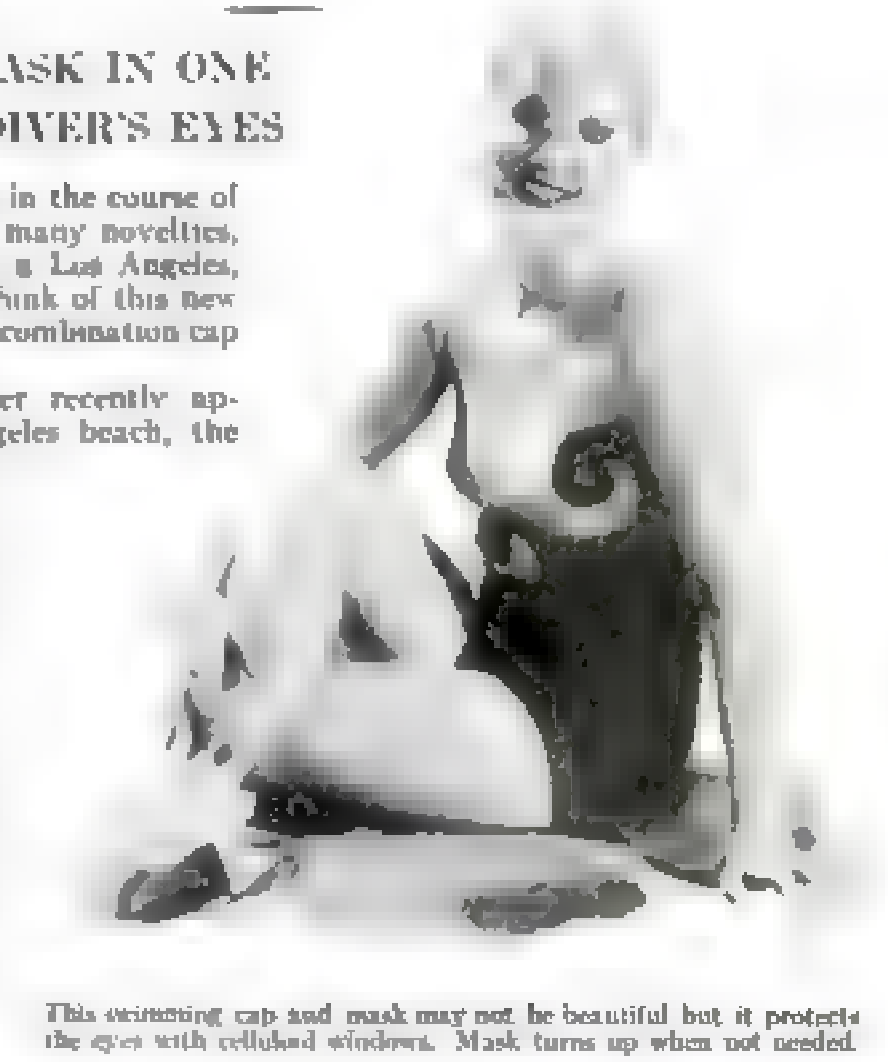
HAILSTONES LAST A YEAR

HAILSTONES that did a million dollars' damage in Moundsville, W. Va., a year ago last March, are still in existence. A dozen of them may be seen today in the ice cream cooler of a Moundsville store. Placed there after the storm, they have been kept by electric refrigeration as large and firm as when they fell.

CAP AND MASK IN ONE PROTECTS DIVER'S EYES

BATHING fashions in the course of centuries have seen many novelties, but it remained for a Los Angeles, Calif., designer to think of this new headgear, which is a combination cap and face mask in one.

When the first wearer recently appeared on the Los Angeles beach, the startling, round eyeholes of the mask might have suggested to a fanciful observer the appearance of a feminine Martian or a lady robot. Despite its oddity, the mask serves the practical purpose of protecting the eyes and ears in diving. Celluloid eyepieces keep out the water. The lower portion of the mask covers half the swimmer's face, leaving the nose and mouth uncovered. It may be turned up when not needed.



This swimming cap and mask may not be beautiful but it protects the eyes with celluloid windows. Mask turns up when not needed.

5,500 THEATERS WILL SHOW TALKING FILMS

How far talking movies have swept silent pictures from the screen is revealed in figures recently given the Society of Motion Picture Engineers. They show that at least 5,500 theaters—three fourths of all the motion picture theaters in the country—will be wired for sound reels by the end of 1930. The total installations of sound apparatus in movie houses throughout the world will probably reach 22,000 by this date, it is also reported.

A handy [illegible] kettle covers and keeps them within reach, thus saving steps.

Out from the side of this automatic toaster pops the golden-brown toast. A timing apparatus is easily adjusted to give satisfaction to individual tastes. Pushing down ejector lever turns on the current.

This sandwich toaster can be transformed, in the twinkling of an eye, into a double griddle and used for cooking pancakes or frying eggs, steaks, or bacon.

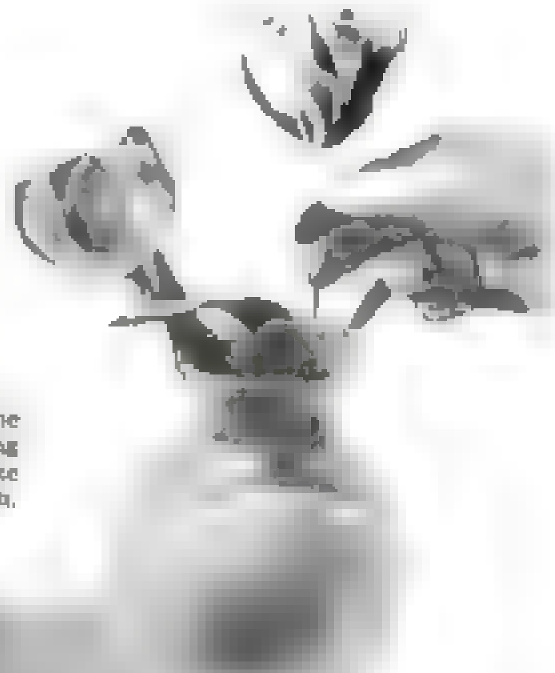
Fifteen New Ideas for the Housewife

Where to put the hot lid of a baking dish is an annoying question conveniently answered by a metal holder that clamps to the side of the dish. It holds it securely against danger of breakage.

An aluminum handle with bristles of bronze wire makes this scouring brush unusually light and also strong enough to clean thoroughly. In addition, it saves the hands from grease and also eliminates the discomfort of handling metal wool.

No baby can come down plump if the window is guarded with this strong wire sash. It can be adjusted to size of any window; screws hold it firm.

Getting around an ironing board in a small kitchen is always a serious problem. This new board, which works on a swivel, solves the difficulty by swinging out of the way so the work is easily accessible.



These vases are not what they seem. They really are made of rubber and are unbreakable. Moreover, they can be re-formed into some other shape if you desire by simply turning the edges into different curves, as shown in the illustration at the left.

A new kind of radiator for house heating has an electric fan [illegible] distribute the heated air. One of the [illegible] an electric motor [illegible] Another shown [illegible] below [illegible]

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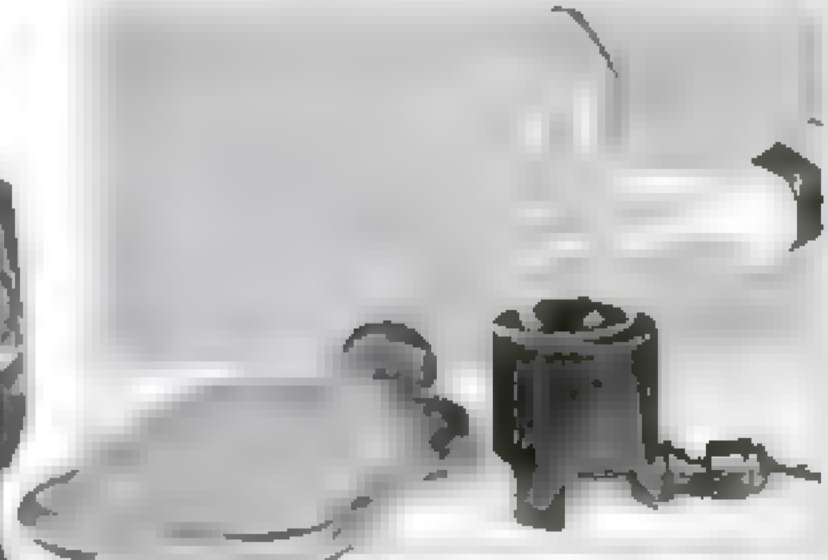

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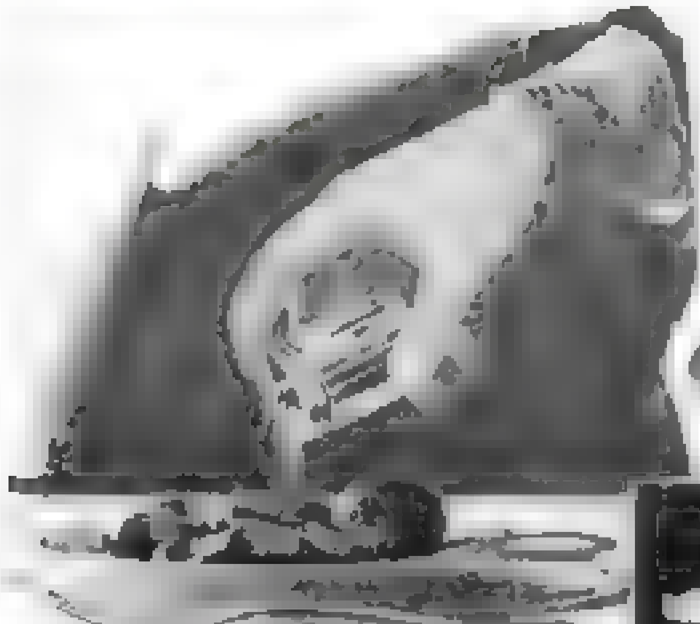

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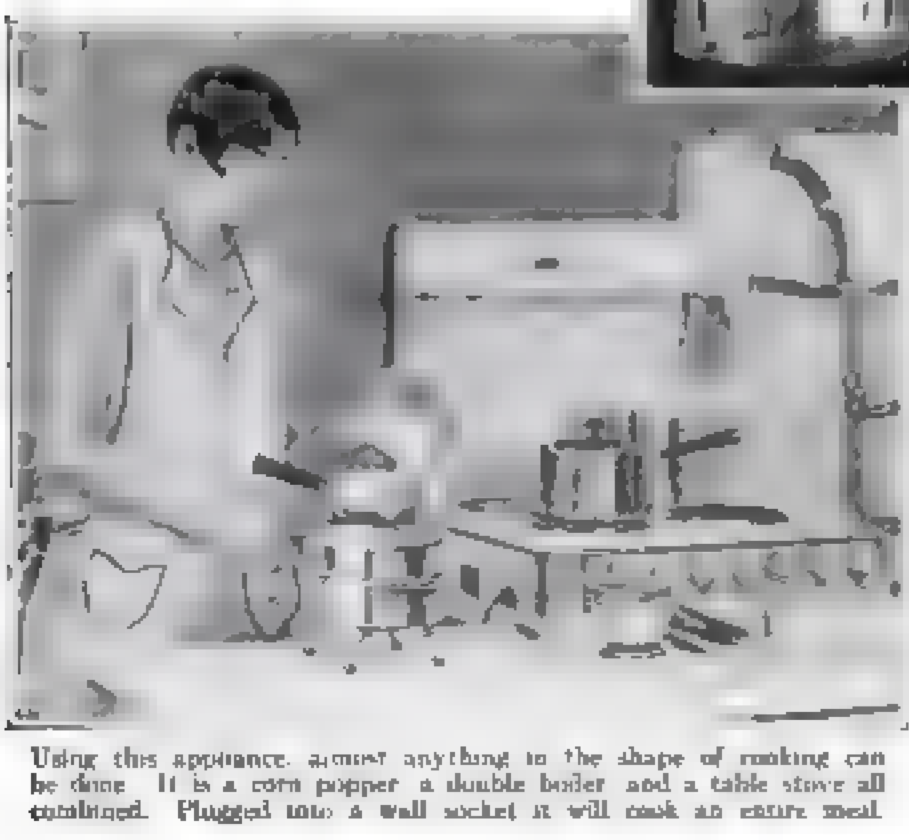

Using this appliance, almost anything in the shape of cooking can be done. It is a corn popper, a double boiler, and a table stove all combined. Plugged into a wall socket it will cook an entire meal.

Popular Science MONTHLY

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We Take You Behind the Scenes

TWO articles in this issue are so clearly illustrative of our method of gathering news and facts for you that we cannot resist pointing out the story behind them.

Some time ago we suggested to Assen Jordanoff that he write for us a comparison of flying in gliders and in power airplanes. Jordanoff confessed that modern soaring flight in sailplanes was somewhat new to him, although he had made a few short hops in homemade gliders as a boy. And of course he was as unwilling to write on soaring without actually flying a modern sailplane as we were to permit him to do so.

There were a few training gliders but no soaring ships around New York, so we got in touch with W. Hawley Bowlus, premier American glider pilot, at San Diego, Calif. Bowlus replied that he had a sailplane we could use—the one, in fact, in which he had taught Lindbergh to glide, the one in which he had made the American soaring duration record which he described in the June POPULAR SCIENCE MONTHLY. We bought this plane from Bowlus for Jordanoff's use. It was rushed across the continent from the Pacific coast. Bowlus came with it and under his instruction Jordanoff flew the glider and learned the new and perfected modern technique. You have the story that resulted on page 36.

There is another story into whose workings we want to give you a peep. It is the one by Bort M. McConnell describing the work of cable ships in recovering and splicing broken ocean cables. It would have been easy for McConnell to have gone to the cable company and let someone tell him how the work is done. Instead, though, he shipped as a member of the crew on a cable ship, and went through the cold and rough seas and hard work. In consequence, his story is written for you with the stamp of truth and verity and is rich with color and life. You will find it on page 56. When POPULAR SCIENCE MONTHLY decides to do a thing, halfway methods are not sufficient!

Ninth Planet Is Now Pluto

THE new ninth planet hitherto known only as Planet X has officially been christened. Its name is Pluto.

This announcement from the Lowell Observatory, Flagstaff, Ariz., which found the new planet, disposes of any doubt that the discoverers were not sure of their planet. Some weeks ago, reports gained wide circulation that the Observatory's director, Dr. V. M. Slipher, doubted that this was really a planet. Vigorously and promptly, he declared that he had been misquoted.

In choosing the name Pluto, members of the Observatory wisely followed the tradition of taking names from Roman mythology, as had been done in naming the other planets. It was fitting, they considered, that the outermost planet in the blackness of far space should be named after the mythological god of the region of darkness. An odd consideration confirmed the choice. Astronomers, among themselves, abbreviate the names of planets. By coincidence, the abbreviation of Pluto, PL, happens also to be the initials of the late Dr. Percival Lowell, whose predictions resulted in the planet's discovery.

Much Talk Suits the Senate

THE United States Senate, which should lead and not lag in the march of scientific progress, recently voted to throw out of the Capitol the modern, efficient dial telephone and go back to the ordinary instrument.

Dialing a telephone requires definite action and gets quick results. Getting a number on the old phone is accomplished by much talk and a lot of waiting—but this, after all, is the conventional method of Senatorial procedure.

We wonder how long it will take the members of the Senate to discover that the ordinary telephone is obsolete and that within a few years it will pass into oblivion to keep company with the dodo bird, the stagecoach, and the mustache cup?

This latest example of the attitude of the Senate toward inventive progress makes more understandable the reasons why our national legislators have permitted the United States Patent Office to fall into the disgraceful condition we have described in the last three issues.

A New Angle on Television

NO HEN standing at the water's edge and disconsolately clucking to her brood of chicks suddenly become ducklings is more surprised than are some inventors.

Inventions have a queer habit of turning from chicks to ducklings. Often they satisfy a need unthought of by the inventor.

Perhaps television may prove to be one of these changelings. Both inventors and public first conceived television to be a device that would make it possible for a man to see a football game without freezing almost to death in a cold stadium.

It looks now as though television is heading in a totally different direction. The latest developments, as outlined in the article on page 15, would indicate that television may itself become an accessory to stage illusions in one form and a means of defeating the aviation fog hazard in another.

A Gallant Airman Passes

THROUGH the death of Henry J. ("Buddy") Bushmeyer last month, American aviation lost one of its most picturesque and bravest figures. Though a product of the old "flying circus" days, Bushmeyer was by no means a mere "stunt man." As instructor of parachute jumping at Roosevelt Field, N. Y., he taught hundreds of student aviators the use of the parachute. The fate which decreed that he should lose his life in a plane crash the one time when he was not provided with this life-saving device seems, therefore, all the more ironical. POPULAR SCIENCE MONTHLY deeply regrets the passing of this fearless airman. It is grateful that it was privileged to publish the story of his remarkable career.

Heating Homes with Gas

LOG fireplaces, Franklin stoves, coal furnaces, boilers with oil-burners—so runs the history of heating the American home. And now we seem about to observe still another chapter in house heating.

Gas heating is the most modern way of keeping a home warm in winter. A mechanical brain, styled a thermostat, automatically regulates the heat, relieving the householder from the task of manipulating drafts. There is no fuel to shovel, no delivery problem, no ashes to carry out. The gas comes underground from the city mains, just as water is tapped from the city pipes.

Gas house-heating is not new in itself. Wealthy residents have used it for years in cities where "manufactured" or artificial gas is supplied. But gas now is becoming more generally available through the piping of cheap natural gas from wells hundreds of miles distant. An article on page 23 of this issue tells how these enormous lines, veritable aqueducts of fuel, have been built during the last two or three years. They seem likely to make over the habits of a large part of the American people.

Headphones for Modern Sets

Reception late at night calls for silence, and headphones come into their own. With most sets loudspeakers can be disconnected and earpiece attachment made at binding posts. Hook-up when you can't reach voice coil.

By

ALFRED P. LANE

Fig. 1. By bending the band to fit the head, phones can be worn for hours at a time.

Fig. 2. Late listeners or distance hunters can use headphones and not disturb others.

IN THE early days of radio there were few loudspeakers and no good ones. Everybody listened with the aid of headphones, and illustrations of the newest sets of that period usually pictured several people attached to the receivers by headphones.

Most people, however, found headphones a nuisance and the development of the loudspeaker proceeded so rapidly that today the headphone is considered a relic of the past. It happens, though, that headphones make possible certain results that cannot be obtained by any other device.

For satisfactory reception late at night without disturbing sleeping members of the household nothing can beat a pair of headphones. If one member of the family is particularly keen on listening to a program that is objectionable to the rest of the family, headphones solve the problem. Partially deaf persons can get satisfactory reception by the aid of headphones.

It is a simple matter to apply a pair of headphones to any modern set. The exact method depends on the hook-up of the loudspeaker circuit. With many types of sets the output transformer is part of the chassis unit itself, and the two binding posts or plug connections marked "loud-speaker" receive the flexible cord tips which are connected to the voice coil of the dynamic speaker.

With such an outfit headphones can be used for reception late at night or for hunting for distant stations merely by removing the cord tips and inserting in place of them the headphone cord tips. The step-down ratio of the output transformer will reduce the amplification, when connected to the headphones, to satisfactory ear volume and will also reduce the hum in the same proportion.

Up to fifteen or twenty pairs of headphones can be connected in parallel in this manner and the method therefore works out well in a small hospital where it is desired to allow that number of patients to choose as to whether they want to listen to the radio or not. If all of the headphones are of the same make the volume can be set for one pair and it will then be right for all the rest.

The loudspeaker itself cannot be used with the headphones connected in this manner because the low resistance of the loudspeaker voice coil would reduce the volume level in the headphones too low.

When the output transformer is part of the dynamic loudspeaker unit or the construction is such that it is impossible to get at the voice coil connection, the arrangement shown in Figure 3 can be used. This will work with any set having push pull amplification in the last stage. A wire is brought out from each of the P terminals of the two power tube sockets, and if it is impossible to get at the power tube socket terminals a piece of fine wire can be wound around the prong of the tube. The plate prong always is the one that fits in the small hole to the right of the pin on the tube base when looking down from above. These two wires are connected to condensers *C1* and *C2* respectively. Condensers should have a rated working voltage of not less than 400 volts D. C. and a capacity of not less than two microfarads each.

Fig. 4. Soldering the protective condensers when a headphone connection has been made as shown in detail in Figure 3.

The lower portion of Figure 3 shows the arrangement necessary for more than one pair of phones. In order to keep the load uniformly distributed, the phones must be connected in a series parallel connection. Only certain numbers of phones work out properly in this arrangement. One pair of headphones is connected as shown in the upper portion of Figure 3. Four pairs of headphones should be connected as shown in the lower section of the diagram. The condensers *C1* and *C2* are eliminated from this portion of the diagram to save space.

The use of one or several pairs of headphones in this way does not interfere with the normal operation of the loudspeaker. By inserting a variable high resistance that can be adjusted to put as much as a million ohms in the circuit at point X in Fig. 3, the headphone volume can be set independently of the loudspeaker.

By bending the head band as shown in Fig. 1 to fit the head, phones can be made so comfortable that they can be worn for hours at a time.

Fig. 3. Diagram showing how to connect phones when voice coil connection cannot be reached.

HELPFUL HINTS FOR RADIO FANS

Keep Voltage Even in Your Set

Changing Current Gives Bad Reception and May Ruin Tubes. Temporary Repairs of Audio Transformer

THE electric light current supply in this country, from which electric radio sets draw their power, is nominally rated at 110 volts. This is the standard electrical pressure the power companies try to maintain. Unfortunately, however, the actual voltage at the wall plug to which you connect the radio set is practically never exactly 110 volts.

If you are lucky the variation may not be over five volts either way; that is, from 105 to 115. In some particularly favorable locations the voltage variation may not be over three volts either way.

In many neighborhoods, however, the voltage variation greatly exceeds these figures, especially if your home happens to be located near the end of a branch power line that is heavily loaded. At five o'clock the voltage may read 112 or 115. Then darkness comes on, everybody starts using electric current for lights, and the voltage may drop in some cases below 100. Then later people begin to go to bed and shut off the lights and the voltage starts to rise. At ten or eleven o'clock it may go as high as 120 or 125 volts.

These variations in voltage are, of course, objectionable even for electric light service, because an electric light bulb gives maximum light economy consistent with adequate life only when operated at normal voltage. On low voltage, the light produced by the heated filament drops off much more than does the flow of current, so that you pay more for the same amount of light. On excess voltage the situation is reversed, and you get more light for the money than you do on normal voltage. This is more than offset by the fact that the electric light bulbs burn out rapidly.

In the radio set, subnormal voltage means a slight lack of sensitiveness and a lowering of the volume output. Excess voltage is much more serious, since it results in rapid exhaustion of the expensive tubes in the set, and, in extreme cases, may cause condenser breakdowns. It is always desirable, therefore, to operate any set on lower rather than higher rated voltage. One way to obtain this result on lines where the voltage varies considerably is to add a controlling resistance, such as is shown in Figure 1.

There are many types. Some are straight resistances and reduce the voltage in the same proportion whether excessive or normal. Others have slight compensating action so that they are more effective on excessive voltages. Eventually radio vacuum tubes will be produced able to stand any excess voltage usually encountered without suffering a shortening of life.

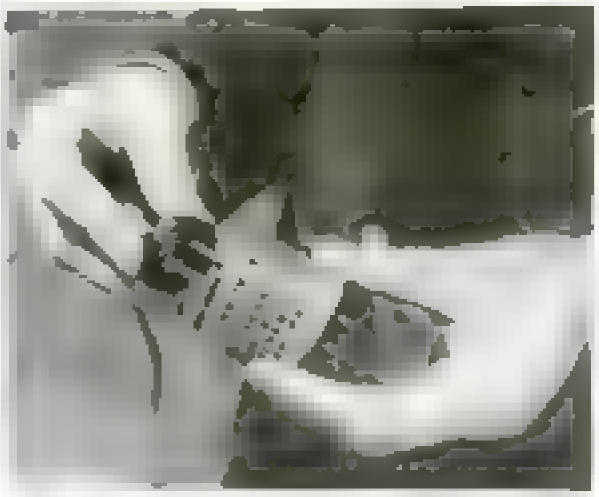


Fig. 1. Controlling resistance device which is needed to keep even voltage flowing into set

A B C's of Radio

A CONDENSER, no matter what the capacity, completely blocks the flow of direct current. Alternating current, no matter what frequency, causes some current to flow through a condenser of any capacity. The larger the capacity of the condenser and the higher the frequency of the current in cycles per second, the greater the flow of current. A .001-microfarad condenser will allow a minute amount of current to flow if frequency is sixty cycles, but the same condenser will permit flow of a big amount of current if the frequency is several million cycles per second.

TRANSFORMER REPAIRS

When the ordinary radio set breaks down the first and most difficult job is to locate the trouble. Loose or broken connections once found are easily repaired but if, as is often the case, the trouble turns out to be an audio transformer that has gone bad, it is next to impossible to repair the delicate winding.

Figure 2 shows a method of repairing temporarily an audio transformer. Condenser *C* should have a capacity of from .006 to .01 microfarads, and in an emergency even a half or one microfarad condenser can be used. If the primary winding on test is open circuited and will not carry current, connect resistance *R1* between the P and B terminals of the primary winding. The value of this resistance should be 100,000 ohms (one tenth megohm). If the open circuit is in the secondary winding, connect resistance *R2* across the G and F terminals. Resistance *R2* should have a value of from 500,000 ohms down to 100,000 ohms.

If both windings are out it will, of course, be necessary to use resistances *R1* and *R2* which will convert the circuit to a resistance coupled stage of amplification instead of a transformer-coupled stage. The amplification will be reduced in any case because the use of *C* and *R1* or *C* and *R2* converts the unit to an impedance-coupled stage of amplification and neither impedance nor resistance coupling will give the amplification obtainable from the transformer.

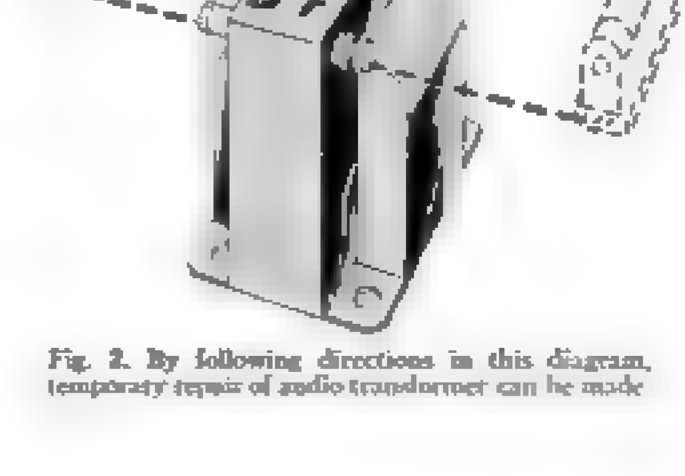


Fig. 2. By following directions in this diagram, temporary repair of audio transformer can be made

SHORT CIRCUIT TESTS

In checking over a radio set that no longer operates as it should the beginner often is fooled. You may, for instance, make a test to determine whether current is flowing from one point to another and find that this particular portion of the circuit apparently is in good shape when it actually is out of commission.

In order to make sure that the current is flowing by way of the wiring you wish to test, check over the circuit and if there is any other possible path by which the current can flow, disconnect the wiring.

When a dealer tests a tube and tells you it's good, you have to believe him, unless you know something about tubes.

Don't Buy Radio Tubes by Looks

Shiny Outside Means Little—What Counts Is Durability of Electron Producing Filament

By JOHN CARR

WHEN you go to buy a vacuum tube the chances are you tell the clerk the kind of tube you want. He picks one off the shelf, unwraps it, and sticks it in the socket of the test outfit. After the tube lights up he turns various switches and presses some buttons with the result that the pointers on the dials of the test set wriggle back and forth. Then he takes the tube out of the socket, puts it back in the box, and takes your money.

Unless you know something about tubes this testing means nothing to you. If the dealer says that the tube is good, you have to take his word for it. That is one reason why it pays to avoid gyp dealers and tube bargain sales.

In one way, at least, a vacuum tube is like a storage battery or a book. You cannot judge the value of a storage battery by its appearance nor a book by its cover.

While accurate workmanship is desirable in any product, a clean-cut, symmetrical appearance, a nicely polished base, and shiny prongs mean little in a vacuum tube. What counts is the durability of the electron-producing cathode or filament, the accurate spacing of the elements, and the degree of vacuum in the tube. Mechanically the only external requirements of a vacuum tube are that it shall fit the socket, that the leads be properly soldered to the prongs, and that the glass portion is firmly cemented to the base.

The operating characteristics of a vacuum tube in a radio circuit, which give it its ability to make your set bring in the broadcasting, can be determined only by electrical tests. These qualities have fancy names, "amplification factor," "mutual conductance," "plate impedance," and so on. Fortunately the meanings of these terms are relatively simple.

The ordinary three-element vacuum tube is, after all, only a sort of an automatic valve for turning on and off electrical current. The filament or cathode shoots out a stream of electrons when it is heated. These electrons, passing from the filament to the plate, produce what we term a flow of electric current. The electrons must go through the grid in order to reach the plate and the grid is the electrical valve. Any change in the voltage applied to the grid results in a change in the flow of the electrons.

The amplification factor of the tube is a numerical expression for the relation between the change in current flow caused by a change in grid voltage compared with a change in voltage applied to the plate necessary to cause the same change in current flow.

If, for example, on a given tube the plate current changed five milliamperes with a change of five volts on the grid and it required forty-five volts change in the plate voltage to make the same difference in the plate current, then the amplification factor would be forty-five divided by five, or nine.

All of these qualities of a vacuum tube are governed by the quantity of the flow of electrons from the cathode and the size and spacing of the grid and plate, and quality in a radio tube implies accurate construction and spacing of the elements.

Figure 1 shows a test hook-up from which these figures can be determined for a particular tube. In this case a 227 tube is shown in the usual Y-type socket, which has five holes. The heater connections marked H are connected to a two-and-one-half volt alternating current transformer. The P terminal of the socket is connected by way of a meter, which reads to thousandths of an ampere (milliammeter), to the plus terminal of the B battery.

The cathode terminal is connected to the minus end of the B battery and to the plus end of the C battery. The grid terminal of the socket is connected to the arm of a single-pole double-throw switch. In one position the switch applies the C battery voltage to the grid of the tube, in the other the grid is at zero voltage.

When the switch is in a position where the C voltage is applied to the grid, there will be a certain flow of current registered on the meter; when the switch is turned to the other position, reducing the grid bias to zero, a much larger flow of current will be noted. What counts, of course, is the difference between the flow in one position and in the other position, and the readings indicate whether or not there is a sufficient flow of electrons from the cathode.

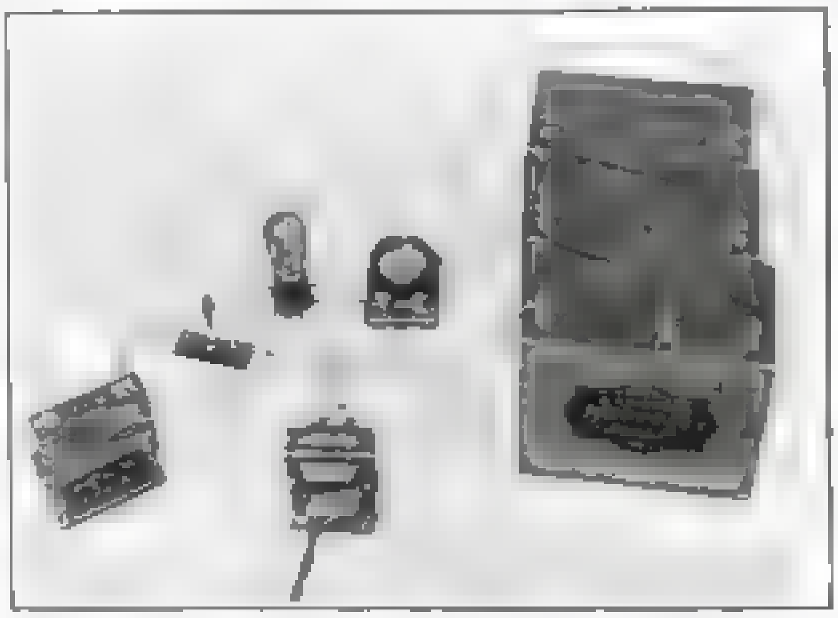


Fig. 1. Test hook-up to show the electron flow and to determine the electrical characteristics in the operation of the tube.

$150.00 in Prizes for Letters about Cars

I HAVE been wondering for some time just how much you, the readers of Popular Science Monthly, actually know about what goes on under the hood of an automobile; whether you choose your cars by the looks of a fancy paint job or a stylish body, or whether you pry into the innards of the car to judge the merits of the machinery that makes it go.

So I have induced the Editor to offer a prize of $75 for the best letter, of not more than 300 words, telling why you bought the car you now own. The writer of the second best letter will get $25 and the writers of the five next best letters will get $10 each—seven prizes in all.

The letters will be judged on neatness and on the skill and accuracy with which you state your reasons for choosing the car you own. The Editor says there are to be no restrictions except that you must be the owner of the car about which you write. You do not have to be a subscriber of Popular Science Monthly nor even purchase this issue from the news stands. Of course, I won't count any entry from any member of the staff of Popular Science Monthly. "Gus Wilson" and the technical staff of Popular Science Monthly will act as judges and their decision will be final. If they decide there is a tie for any prize, the full amount of the prize will be paid to each tying contestant.

Address your letters to me, care of Popular Science Monthly, 381 Fourth Avenue, New York City, and be sure to mail them not later than August 15, 1930, as the contest closes on that date.

Please give me the real dope, not just a lot of words copied from a catalogue or advertisement!

—Martin Bunn

Gus and Joe Are Real Live Men

By MARTIN BUNN

Gus lives and learns each day and is busy passing his knowledge on to his customers

MANY readers of Popular Science Monthly have asked me if Gus Wilson is a real, live man and if the Model Garage actually exists. The answer to both questions is yes. The Model Garage is located in a town not far from New York City. It is owned and operated by two men whom I have named in my stories Gus Wilson and Joe Clark. These are not their real names nor is their place of business called the Model Garage. But don't ask me to tell you what their real names are or where the garage actually is located. I can't do it because years ago when this series of stories first started, I promised never to reveal these facts.

I can assure you, however, that I have done my best to describe "Gus Wilson" as he really is. Even the drawings of Gus which illustrate each story look like the real man because they are made by an artist who knows him.

The incidents in the stories are taken directly from the veteran auto mechanic's own experience.

While I cannot reveal "Gus's" real name or where he lives and works, I can without any breach of confidence tell you a little about his past history.

"Gus Wilson" grew up with the automobile industry. When Duryea was experimenting with his first gasoline buggy "Gus Wilson," then a young man, was investigating and incidentally overhauling one of those funny little steam vehicles that had to stop at every horse trough while the driver sucked into the tank, with a length of hose and a hand pump, gallons and gallons of water.

When the first electric hansom cab hummed and groaned its snail-like course over the streets of New York, Gus was adding water to the batteries, sandpapering the commutators of the motor and otherwise mothering these clumsy vehicles.

His wrist still is a little stiff because years ago the huge one-cylinder engine of a Northern runabout (a competitor of the original Oldsmobile) kicked back and broke several wrist bones.

He has worked on almost every kind of an automobile ever made, and yet with all his experience he remarked, a while ago: "I'm learning some new queer kink about a gasoline motor every day."

Like many exceptionally generous and kind-hearted men, "Gus Wilson" hides his friendliness under a gruff and growling manner. His bark, however, is much worse than his bite, and he is always willing to give all the information at his command to any motorist who is honestly striving to get better results from his car.

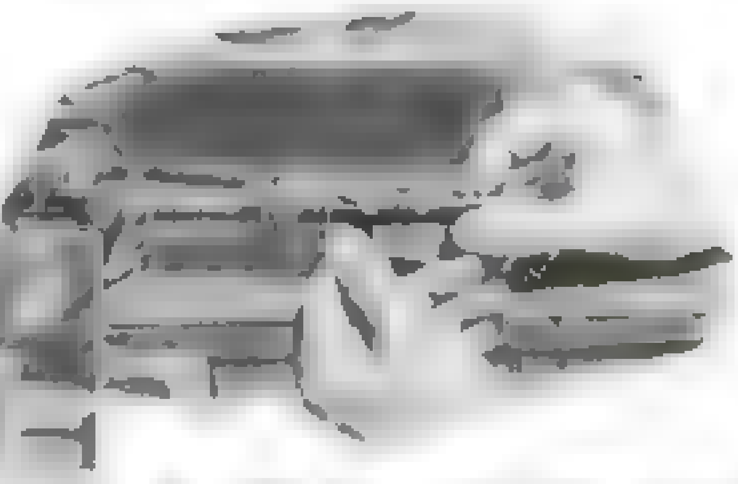
I feel safe in saying that motorists in general would be a lot better off if all auto mechanics had as much skill and knowledge of automobiles and took as much genuine pride in fine workmanship as does "Gus Wilson."

POPULAR SCIENCE HOME WORKSHOP

Articles on Furniture, Models, Toys, Sporting Equipment, and All Forms of Craft Work Better Shop Methods—The Shipshape Home

How to Put a Ship in a Bottle

Making a full-rigged model that folds so as to enter the neck



[illegible] folded, [illegible] he bottle

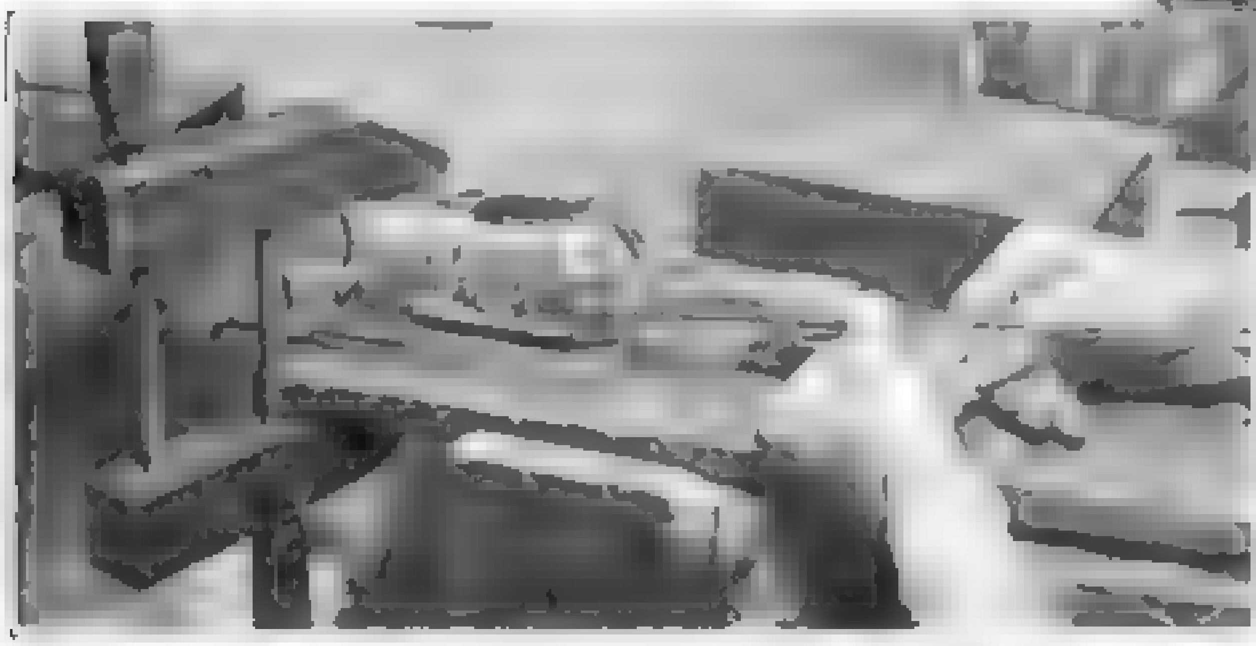


Fig. 2. Arranging the rigging with a long wire while the hull is held in position with a heavy wire hook. Note that the threads, which lift the masts, and the hull hook are held with the left hand

By E. ARMITAGE McCANN

"HOW did it get there?" is the question always asked when a ship model in a bottle such as shown in Figs. 2 and 3 is placed on exhibition. You will observe the curious minded examining the bottom of the bottle to see where it was cut to admit the ship, or they will even inquire if the bottle was blown around the ship. But there is no fake about it everything goes through the neck. With patience and determination, anyone can make this curious and always mystifying type of model.

First, get a clear glass bottle and clean it inside and out. If the neck is large, the work will be easier, if small, the result will be more intriguing.

Although any kind of ship can be made, this work was in fashion among the clipper ship sailors, therefore a clipper especially as it is long and slender, is well adapted to the purpose. We shall describe a full-rigged ship. It will not be exactly to scale, but the closer one can keep to the correct scale, the better the result.

Larger drawings, which will make the work considerably easier can be obtained by sending fifty cents for POPULAR SCIENCE MONTHLY Blueprints No. 121 and 122 (see page 103).

$100 IN PRIZES

Construct a ship model in a bottle and enter it in the POPULAR SCIENCE MONTHLY Ship-in-a-Bottle Contest. For further particulars and rules see page 99.

The hull is slightly more slender than the usual shape and cut off a little below the water line. It should occupy not more than half the neck of the bottle. The top should be cut into so as to leave the bulwarks standing, this also gives [illegible]ts and gear. The bottom [illegible]wed as shown in Fig. 5 [illegible]h the hull to any clipper [illegible]e usually, just black [illegible] or green below the [illegible] line. Deck houses, [illegible]oats, and [illegible]teering gear can be added if desired.

[illegible] the hull will later be set in putty in the bottle, you must ascertain what the distance will be from the deck, when in position in the putty, to the inside of the bottle, so that the masts may be as long as possible yet not too long to stand upright.

The masts may well be in one piece with steps cut in them to represent the lowermast, topmast topgallant mast, and royal mast. Make them as slender as you can with sufficient strength to allow them to be strained on after the necessary holes have been drilled. Straight grained hickory, birch, or maple is suitable. These suggestions apply also to the bowsprit and jib boom.

The yards, spanker boom, and gaff are nicely rounded little sticks, tapered to the ends.

The principle of getting the ship in is merely this: All the masts have to fold down on the deck and then be erected when in the bottle by means of the hauling stays.

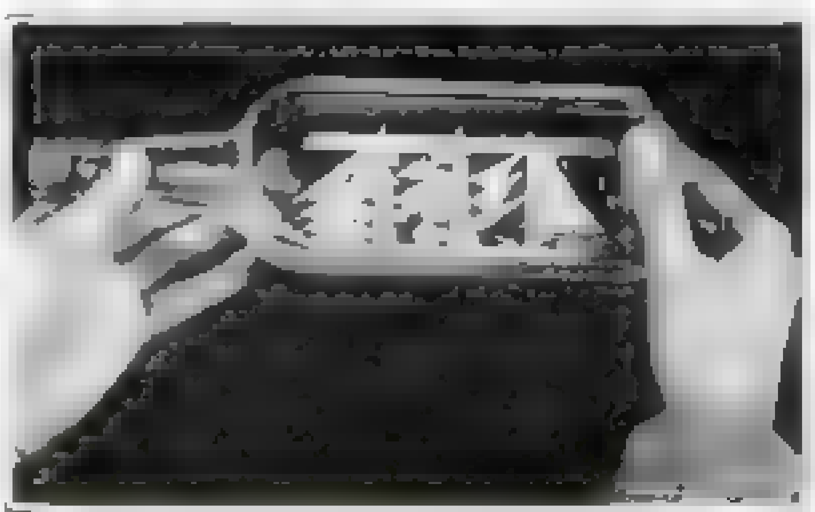


Fig. 3. Full-rigged models with sails also can be placed in a bottle. Applying sails, however, makes the task more difficult.

Each of the masts should have little tops and crosstrees of wood, celluloid or fiber—and caps as well if you like. Above and below the crosstrees of the foremast, holes pass through what appears to be the division between the lowermast and the topmast (see Fig. 4). Also drill the fore-and-aft holes as indicated for the stays, as well as a small hole for the futtock shrouds below where the top comes, and holes for the bitts.

The mainmast will be drilled in the same way, with the addition of athwart holes for the mizzen

Fig. 4. The first step in the rigging is to attach the masts with hinges, the next is to rig the stays, which are used to lift the masts. Then the shrouds and backstays are rigged. For explanatory sketches see Fig. [illegible]

braces. The mizzenmast needs no holes for stays, but has to have them for the main braces as well as one each for the spanker boom and gaff. At the lower end each mast is slightly rounded, and a small hole is drilled for the hinge wires.

If you make the masts of three separate spars, they must be firmly joined. In that case the shrouds and backstays will pass between them instead of through small holes as in the model illustrated.

The bowsprit has three vertical holes for the head stays, and the boom and gaff each have one hole at the mast end. All the spars may be white, black, or varnished.

The next step is to rig her up outside the bottle. Two or three different thicknesses of thread should be used—say No. 50 black thread and No. 70 white or natural.

Fix the bowsprit firmly into a hole in the bow and rig it as shown in Fig. 4. These ropes can be hitched to the boom and pegged into the hull.

Fasten the yards to the masts in their correct positions by first tying a thread tightly around the center of the yard with a double knot abaft and then carry the thread around the mast, so that they will remain in position, yet can be turned to lie along the masts (see Fig. 5).

The spanker boom and gaff should be tied to the mizzenmast with the thread through the drilled holes.

STARTING with the mizzenmast, hinge each mast to the deck by carrying a wire through them at a point down through the hull, twisting the ends together underneath. You should be able to turn the masts down flat on the hull. Fasten the stays and reeve them through the hull or through the next mast and then through the hull or jib boom as indicated in Fig. 4, leaving the ends long enough to pass out of the bottle with plenty to spare.

The end of the mizzen topmast stay is pegged to the deck at the stern, then the stay is hitched around the boom and gaff and hitched again at the crosstrees. This will prevent the masts from coming too far forward when hoisted.

Raise the masts and hold them in position by pegging the forestay where it comes out of the hawse pipe.

The easiest and neatest way to set up the rigging is to bore holes through the hull into the opening beneath as shown in Fig. 5. Thread a No. 9 needle with the heavy thread and start by pegging the thread end in the foremast hole, then reeve through the mastheads and holes until all are up and tight when the mast is in position. The lifts and braces for

each yard can be rigged as one. Start at one yardarm with a knot, reeve through the masthead, and knot to the other yardarm. Then, for the braces, reeve through the hole in the other mast or through the hull and carry the thread back to the first yardarm. The lift part of these lines should be painted black. All these threads must slide readily through their holes. Rubbing them with wax helps. The completely rigged model is shown in Fig. 6.

You may give the model topmast shrouds, rove through the top and a hole below the yard, and if you care to take the time, you may also add ratlines (steps) of very fine silk, although this is rarely attempted.

Now ease up the forestay, lay the yards along the masts, and lay the masts down on the deck. Make sure that all will go into the neck of the bottle, but do not let the model slip through. Draw it out and see if the masts will stand up again and the yards swing across. Then fold them down snugly once more.

Fasten the bottle with a clamp as shown in Fig. 2 so that it will not slip about while you are working on it. Put a layer of blue or green colored putty in the bottle after adding a little varnish to make it more tacky and to insure that it will dry firmly.

Sit in a good light and slide the hull with its gear into the bottle (see Fig. 1). With a long, stiff wire, press it into the putty sea. Untangle the end of the stays which extend from the neck and, still holding the model down, pull them one after the other, but be careful to do all the straining on the lower stays. At the same time, help the masts to rise with a bent wire. This operation is shown in Fig. 2.

When you have all the masts up, fasten the threads to the neck of the bottle, outside, and put a touch of glue where they come out of the hawse pipe and through the jib boom. Next, use the wire hook to swing the yards into position.

After the glue is dry, cut the lines off close with a sharpened wire, such as is shown in Fig. 7.

Additional picturesque touches can be added by inserting a lighthouse on a rock, a pilot boat or tugboats, and one or more fishing smacks in the water alongside.

As the ship is to be without sails, one or both anchor cables should come from the hawse pipes to the water.

Occasionally a bottle model is seen with sails, such as the one illustrated in Fig. 3. While the principle of assembling a model of this type is exactly the same, the addition of the sails, which are made of thin flexible paper, complicates the work

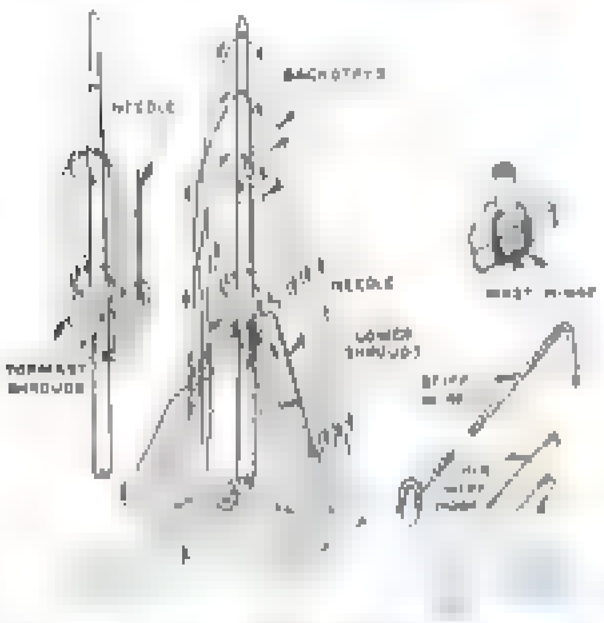


Fig. 8. The process of folding the masts and rigging and how the model is inserted in the neck of the bottle. All of the drawings on pages 72 and 73 are full size except the perspective sketches. Double size plans together with full size drawings are contained in Blueprints Nos. 121 and 122 (see page 103).

Machine Sawing from on Top

By WILLIAM W. KLENKE

An expert's impressions of a new type machine, and a built-in Colonial corner closet design

HAVE we been doing our machine sawing upside down? I wonder—and so will you before you finish reading this article

Let's review for a moment a previous article on "Mastering the Use of a Circular Saw" (P. S. M., Nov. '29, p. 88). Note how all the cutting is done from the underside. With that type of machine—the standard design for a circular saw—the cutting is never in sight until the saw has made its way through the wood. This disadvantage is even more pronounced in grooving, for in that case the cut cannot be seen at all until finished. Furthermore, when we cut from the underside, the saw has a tendency to force the wood upward. This is even more true when the saw becomes dull and binds, and in extreme cases it may cause an accident

In the relatively new type of saw illustrated, the cutting is done above the table. By studying the photographs (especially Fig. 2), you will note that the operator need not hold the wood when cutting, for the tendency of the saw is to force the wood down on the saw table and against the fence. As a safety principle, this is a noteworthy and commendable feature of the machine.

Fig. 1. A built in corner closet utilizes space that is rarely used and allows the attractive display and storage of china and glassware

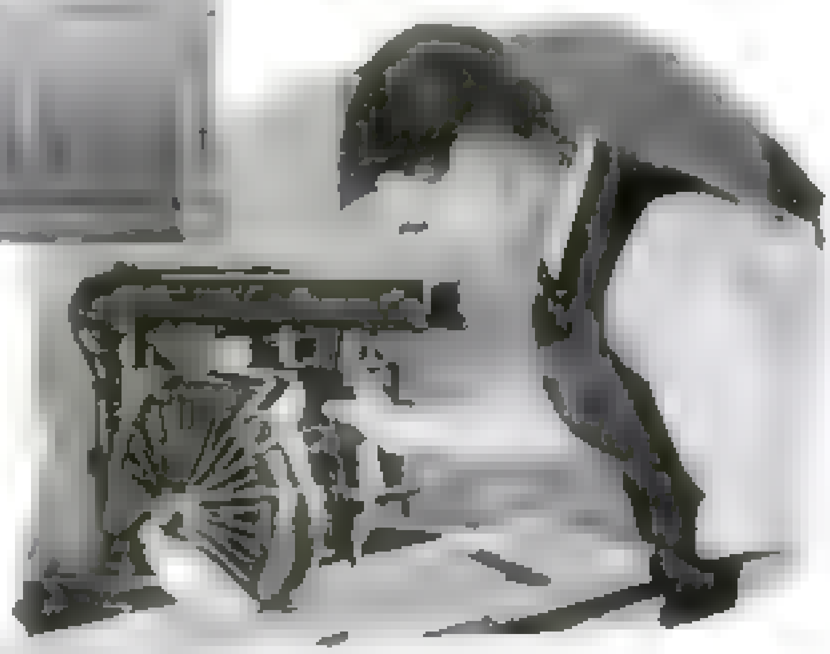


Fig. 2. The stock need not be held since the saw forces it against the table and fence. The guard is adjustable, allowing a maximum amount of saw blade to be covered

Have you ever been confronted with the problem of trying to cut off long pieces of wood on a small saw table of the underside type? It is not easy to control the extra length. With this new type of machine, the wood remains stationary for crosscutting and the saw is pulled over the material to be cut. By adding extension tables to either side, any length of lumber can be handled.

Angular cuts are made by tilting the motor and saw as a single unit. The ease with which the saw can be set at any angle is especially appreciated for making compound cuts such as in the cutting of a double miter—as in Fig. 4. For resawing, cutting tenons, and similar work the saw is placed in a horizontal position as illustrated in Fig. 3. The circular saw also can be quickly and easily converted into a shaper or molding cutting outfit with almost unlimited possibilities (see Fig. 5)

As a project to accompany this brief description of the overarm saw, I have chosen a built in Colonial corner china closet illustrated in Figs. 1 and 7. This style of closet is exceedingly popular today. It is built in the corner and therefore utilizes space that is rarely used. It provides a very useful storage and display space for beautiful china and glassware. Closets of this type are often built in pairs.

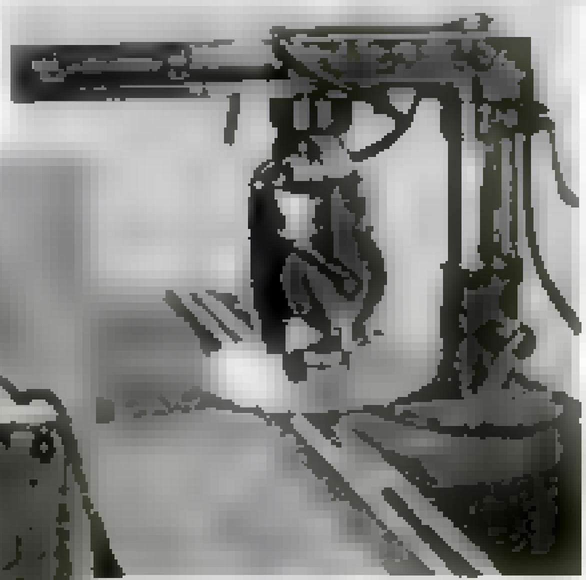


Fig. 3. *Above:* Position of the saw for resawing and cutting tenons

Fig. 4. *Left:* Cutting a double miter such as is found on the end of a jack rafter. Note how the entire motor and saw unit is set at an angle.

While the greater part of this cabinet can be worked out on the machine shown, it can also be built with other outfits or even with hand tools alone. The steps, briefly outlined, are as follows

Step No. 1—Stock. Get out all stock, using a combination saw blade to insure a smooth cut. (For the care of saws see P. S. M., May '30, p. 86.) Since the closet is to be painted, whitewood is a good stock to use.

Step No. 2—Moldings. Work out the various moldings to the design shown. If you have no molding cutting outfit, moldings that will answer the purpose can be bought at the lumber mill.

Step No. 3—Curved Work. With the aid of a band saw, cut out the curved headpieces and the top of the sash (door). For information on the use of band saws see P. S. M., Feb. '30, p. 86.)

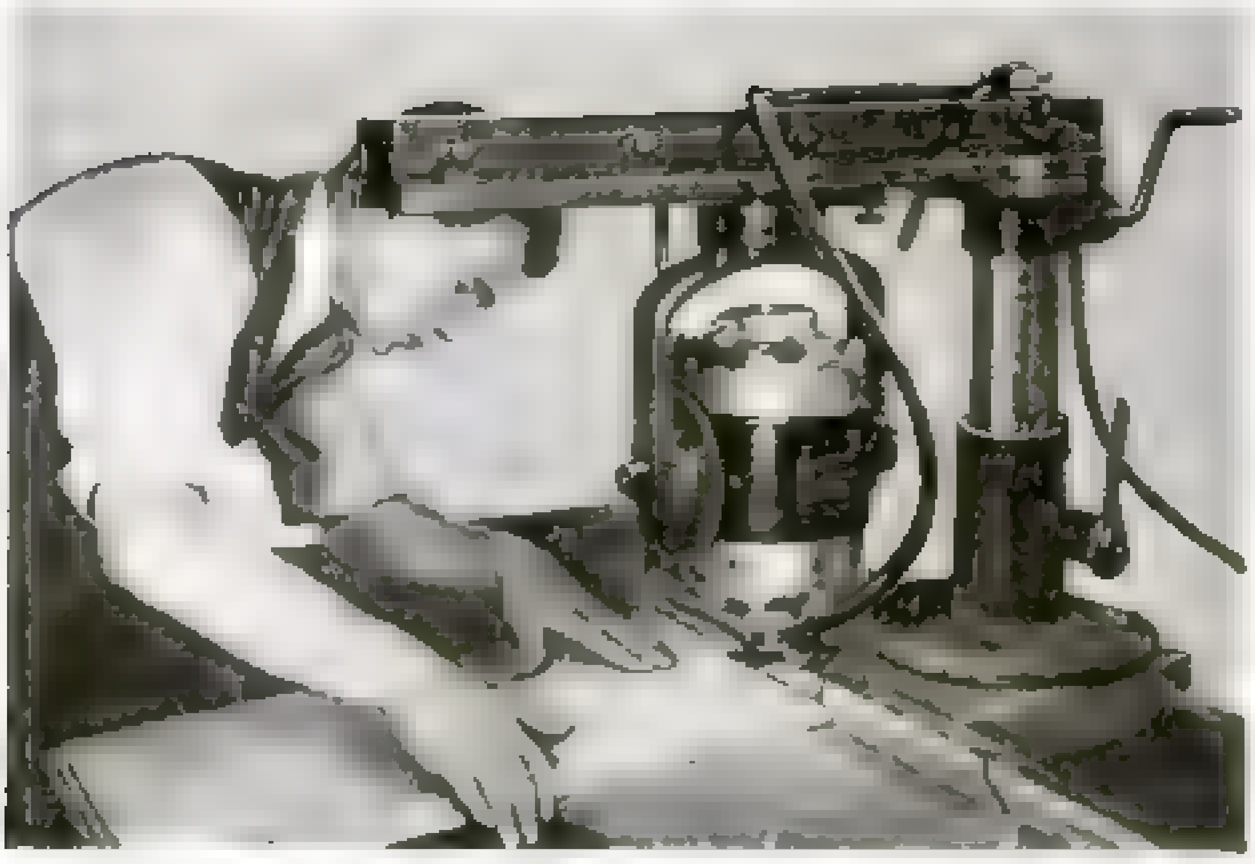


Fig. 5. The machine can be converted into an efficient shaper by setting the shaft in a vertical position and inserting a shaper cutter. This illustration gives an excellent view of the entire machine

Step No. 4—Joints. Make all necessary joints, be sure to allow for the sash molding

Step No. 5—The Jamb. Prepare a form out of scrap material for gluing and shaping the five-ply stock for the circular head of the jamb (see Fig. 6). Fasten the completed jamb to the two sides with screws.

Step No. 6—Cleaning Up. Thoroughly

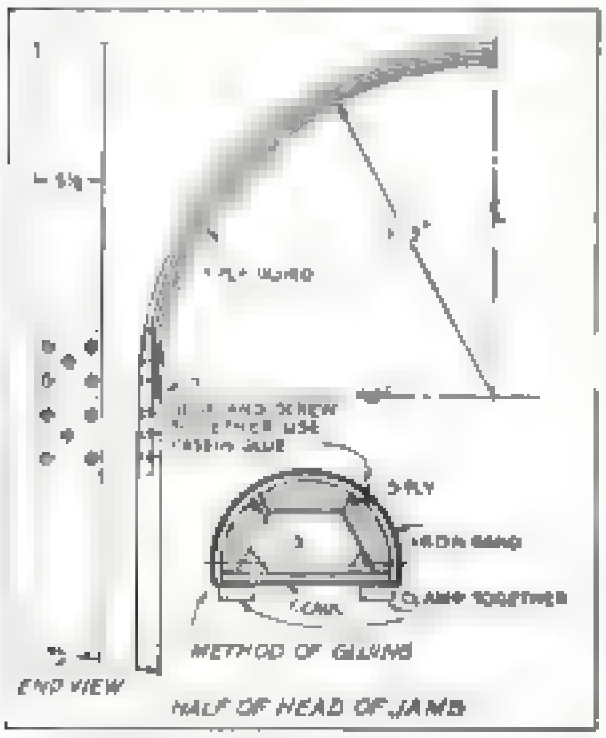


Fig. 6. Detail of the head of the jamb and the method of shaping it over a curved caul or form

smooth all the parts with Nos. 1 and ½ sandpaper, using a sandpaper block to insure flat surfaces

Step No. 7—Building the Closet in Place. Carefully plumb and level the jamb while setting it up. Nail this securely to the walls after putting the necessary blocking in place. Fasten the shelf cleats to support the shelves and fit the shelves in position. Now nail the front casings, moldings, etc., in their correct positions

Step No. 8—Hanging the Door. Fit and hang the door to open freely. Start with the hinge side. A circular plane if available, should be used to fit the curved top. The bottom cupboard can be designed to take a pair of doors or can be used for a drawer

Step No. 9—Final Cleaning Up. Hand sandpaper all parts with No. 0 sandpaper slightly round all corners. Countersink all nails.

Step No. 10—Finishing. Much of the Colonial woodwork of olden days was painted in white or ivory, so I shall give directions for a paint and enamel finish. Apply a thin coat of white shellac and sandpaper when dry so as to cut down the raised fibers of the wood. Apply one coat of lead paint mixed with one part raw linseed oil and one part turpentine, adding a small amount of drier. When dry, putty all nail holes, and lightly sandpaper the surface with No. 0 sandpaper. Apply two coats of flat paint in whatever tint you prefer, rubbing down between coats with No. 0 sandpaper. Then put on a coat of good quality enamel in the proper shade. If you wish the finest quality of finish, apply a second coat of enamel, allow it to dry thoroughly, and rub it down with pumice stone and water to an eggshell gloss. This last coat of enamel may be omitted and the work of rubbing avoided by using an eggshell enamel instead of gloss enamel.

Mr. Klenke, in his next article, which is the last of this series on the use of small motorized woodworking tools, describes the use of the shaper.

TESTING YOUR FUND OF WORKSHOP FACTS

HOW many of the fundamental facts concerning house repairs, finishing painting, lathe work, and general wood and metal working have you at your finger tips? The multiple choice questions below are designed to test your knowledge of a few of the handy man's A B C's.

Try them, crossing out the incorrect terms, and then turn to page 98 to see if you have scored a perfect mark.

(1) The teeth on a (*crosscut*) (*rip*) saw are beveled

(2) (*Alternating*) (*direct*) current is used in plating and similar electrochemical reactions.

(3) Shellac is thinned with (*oil*) (*alcohol*)

(4) A good average speed for wood turning in a lathe is a cutting speed of about (*1,000 to 1,500*) (*3,000 to 4,000*) feet per minute

(5) Oak, walnut, ash, mahogany, gum, and chestnut are all (*open*) (*close*) grained woods

(6) Brushes used for house painting should be cleaned with (*alcohol*) (*gasoline*)

(7) The (*fore*) (*block*) plane is larger than the jack plane

(8) The (*hair*) (*flesh*) side of the leather belt should run on the pulley

(9) More oil is contained in (*flat*) (*gloss*) paint than in (*flat*) (*gloss*) paint.

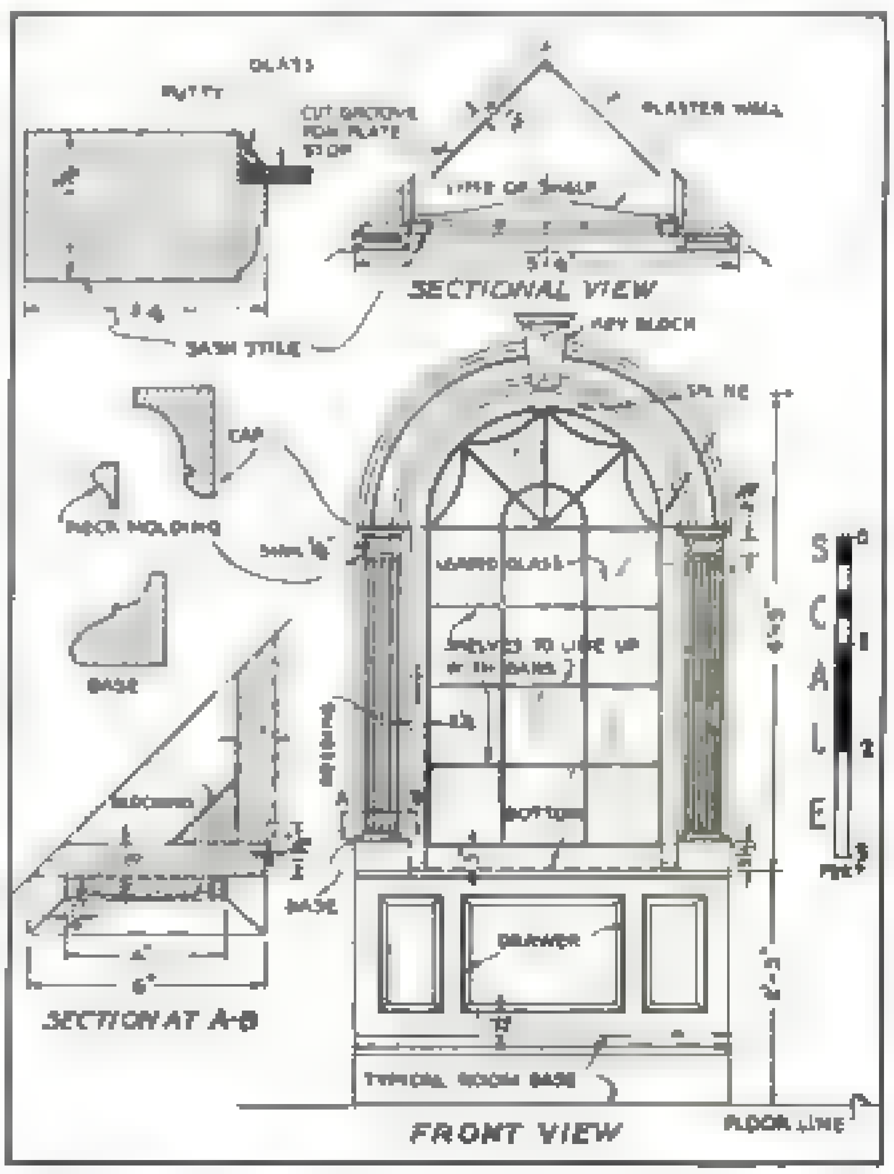
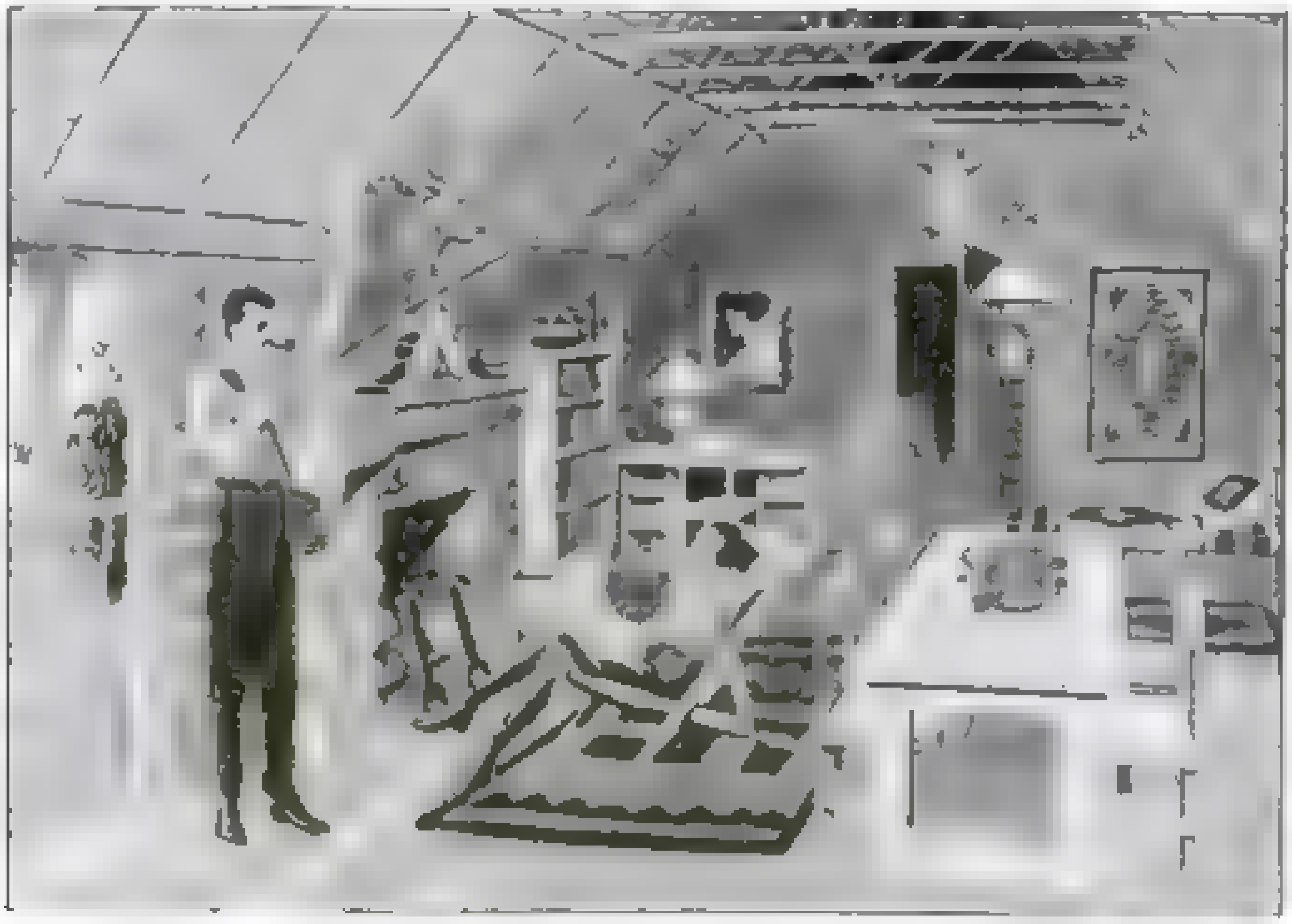


Fig. 7. Assembled views of the built-in china closet, details of the shelf construction, sash stile, and moldings, and section of the corner frame

Packing-Case Camp Furniture



Comfortable and adequate furnishings are necessary if the vacation cottage is to be livable and homelike

By HERMAN HJORTH

Author of Principles of Woodworking

BEFORE Rear Admiral Byrd started out on his great adventure to the South Pole, he had, with his characteristic foresight, provided plans not only for his camp buildings, but also for the furniture they were to contain. Now that the camping season is upon us, it behooves us likewise to plan in advance so that our vacation at the summer camp or cottage—be it by the sea or mountain lakes—will be pleasant and comfortable.

Camp furniture need not be elaborate or expensive, provided it is of correct proportions and sturdy construction. The pieces of furniture illustrated and described in this article and one to follow may be built at home and assembled at the camp. The materials, in the main, may be obtained from discarded packing boxes.

The construction of the *writing desk* in Figs. 1 and 2 hardly needs any explanation. It is important, however, that the four uprights *A* are exactly of the same length and that their ends are square. Indeed, it is a good plan to clamp or lightly nail them together before planing the ends. If a plywood back is nailed to the body of the desk, the construction will be much stronger and firmer. The side compartments are 12 in. wide, the shelves being spaced to meet the individual needs.

The desk rests on four blocks nailed to the underside. These are covered by a simple molding or base piece. The desk top, which is 20 in. wide, will have to be made by gluing two pieces together. The top is fastened to the body of the desk with screws inserted from below. It is then planed and smoothed.

The *table*, Figs. 1 and 3, may be used as a library table or as a dining table, or for both purposes. The ends are made by first nailing pieces *C*, *D* and *E* together as shown in the isometric sketch, then fitting and nailing the filler pieces *F*, *G*, and *H*.

The appearance of the ends may be enhanced by nailing pieces of plywood to their sides and edges as suggested at the lower left corner of Fig. 1. The square openings are made to give more knee room to anyone sitting at the end of the table. If the top is made longer, so that it extends about 12 in. over each end, no openings need be cut. Good pieces of plywood may often be obtained from the better class of packing boxes, such as those used for radio cabinets.

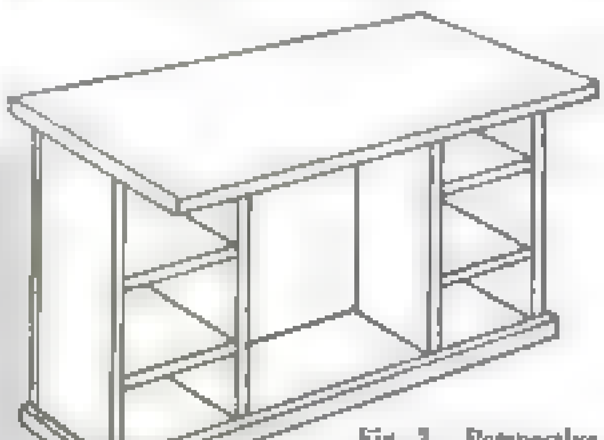


Fig. 2. Perspective sketch of the desk

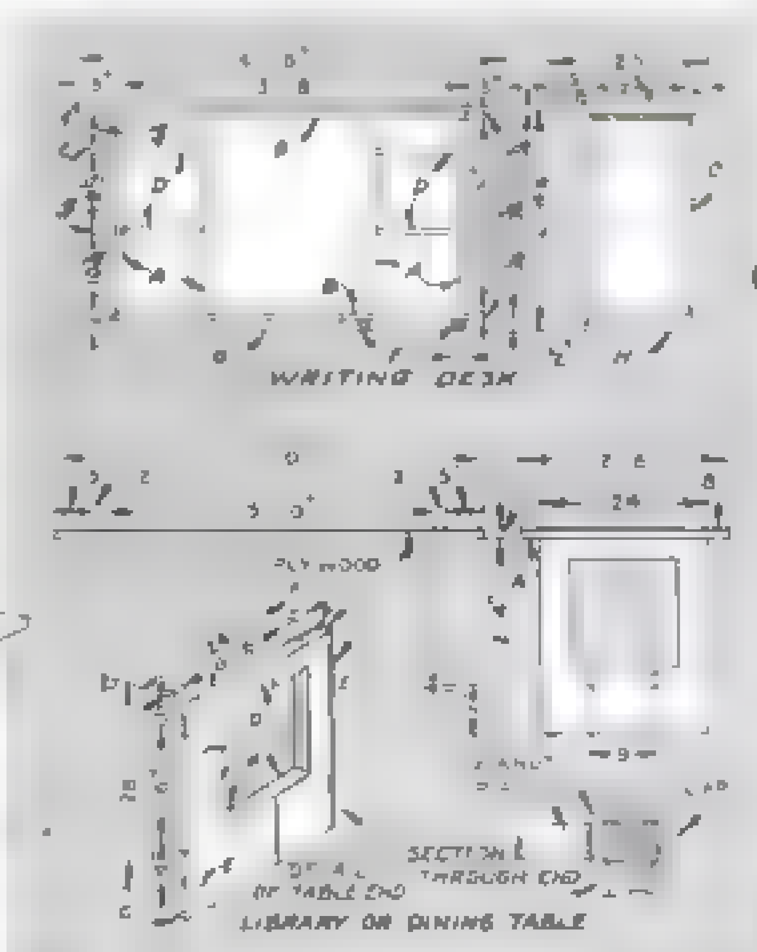


Fig. 1. Assembled views showing the construction of the easily built writing desk and the library or dining table.

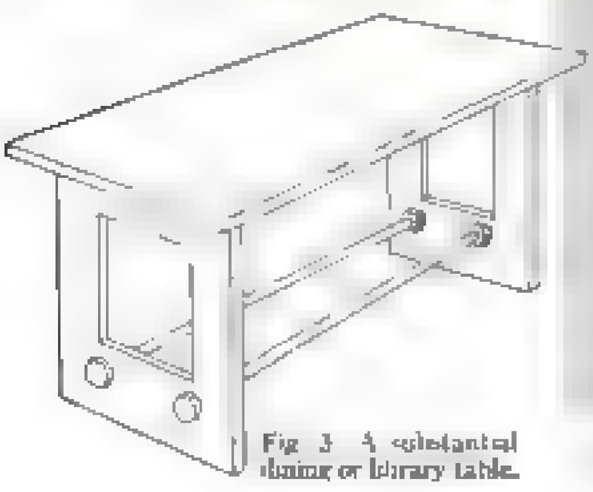


Fig. 3. A substantial dining or library table.

The ends are held together by two pieces of ¾- or 1-in. water pipe. Brass pipe, which is used a great deal in modern plumbing and therefore can be obtained without difficulty, is much better looking, of course, than the ordinary galvanized iron pipe. A board or plank may be substituted for the pipe, if that type construction is desired.

The top consists simply of boards nailed to the end pieces. These

"RCA Radiotrons banish the troubles caused by poor tubes"

says

ALFRED H. GREBE

President, A. H. GREBE & CO., INC.

"THE Grebe Radio standards of precision of manufacture imply the use of vacuum tubes of the highest quality. RCA Radiotrons are the last word in vacuum tube design and construction. They improve musical reception. Because of their uniformity and dependability, they banish the troubles so often caused by poor tubes. That is why we say to every Grebe Radio owner: 'Insure the finest performance of your set by *always* using RCA Radiotrons.'"

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Old tubes may impair the performance of the new.

RCA

This is the 21st in a series of endorsements of RCA Radiotrons by the leading radio set manufacturers.

RCA RADIOTRON CO., Inc., HARRISON, N. J.

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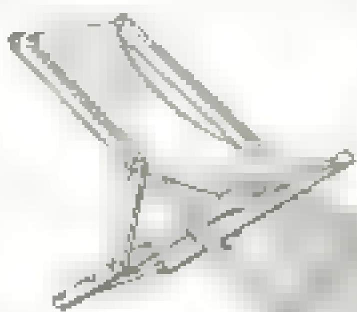
should be covered with a piece of plywood, screwed or nailed in place.

The *chair*, Fig. 4, may be used either for the writing desk or as a dining chair. Cut the front and rear legs first, then nail the four cleats to these as shown in the plan view. Cut the rails and stretchers, and screw and nail the framework together with joints arranged as shown in one of the small detail sketches. The wooden seat may be fastened to the rails with two 3-in. screws driven through each rail from below.

The back is formed by bending a piece of ¼ in. plywood and screwing it to the top of the rear legs after these have been cut as shown in the other small sketch. If ¾ in. is cut off the bottom of the rear legs when the chair is finished, it will be more restful. A pad, which can be bought or made very cheaply, will make the chair still more comfortable and attractive.



The *deck chair*, Fig. 5, is very easy to make if straight grained hardwood is selected for the framework. Broom handles may serve in place of the dowels. When boring the holes for these, clamp the pieces to avoid splitting the wood. Hold the dowels or pieces of broom handles in place with a little glue and a screw. Bore the half-round holes in the sidepieces of the seat frame by clamping them together edgewise and boring in the center.

The canvas for the seat should be nailed to the under side of the dowels. Its length is determined by the distance between the front dowel in the frame for the seat and the upper dowel in the back frame when the chair is folded flat.

The *bookcase*, Fig. 6, differs from the conventional form in that the base is narrower instead of wider than the case proper. This new idea, which has been developed by designers of modernistic furniture, is to provide more toe room.

It is best to build the bookcase and its base separately. The shelves and sides of the case are merely nailed together. Note that the bottom and the top pieces are 1¾ in. longer than the intermediate shelves so that they can be nailed to the ends of the sidepieces, thus preventing the latter from pulling apart. The filler pieces, *G*, *H*, and *I* serve to support the weight of the shelves when loaded with books. The filler pieces *K* are inserted merely for the sake of uniformity in appearance.

The case is materially strengthened and braced if a plywood back is nailed to it. If a back is not desired, the corners at least should be braced by pieces of plywood glued and nailed across them.

The base is nothing more than a box without cover or bottom. It should be leveled and firmly nailed to the floor or baseboard before the bookcase proper is placed on it. It may be well to fasten the two together with several screws.

In designing a bookcase, its width, height, and distance between shelves [illegible] is [illegible] pendent upon the wall space it is to occupy and the number and size of books it is to hold. Careful planning is [illegible]

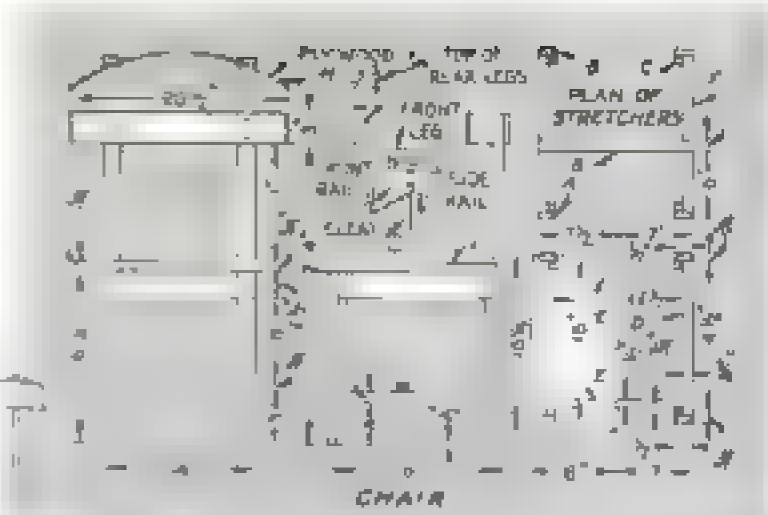


Fig. 4. Assembled views and a perspective sketch of a chair for use with desk or table

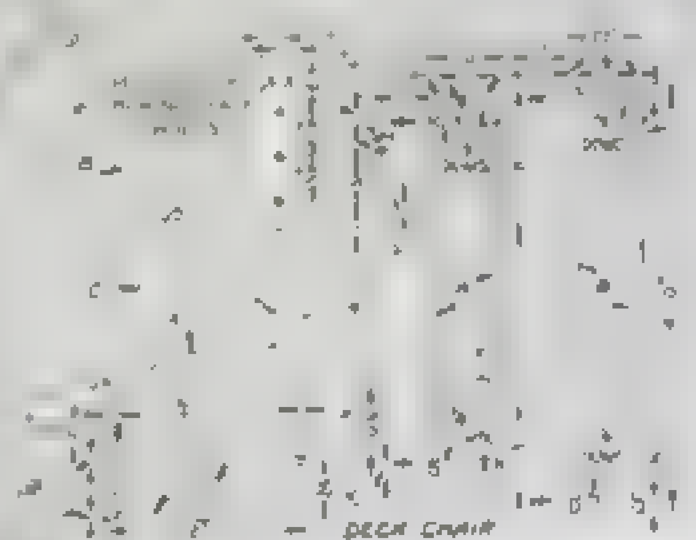


Fig. 5. Hardwood is used in the construction of the comfortable folding deck chair shown

Both finish and color will depend upon the kind of material used in the construction and the color scheme of the cottage.

In a [illegible] article Mr. Hjorth will describe a [illegible] chair of simple design

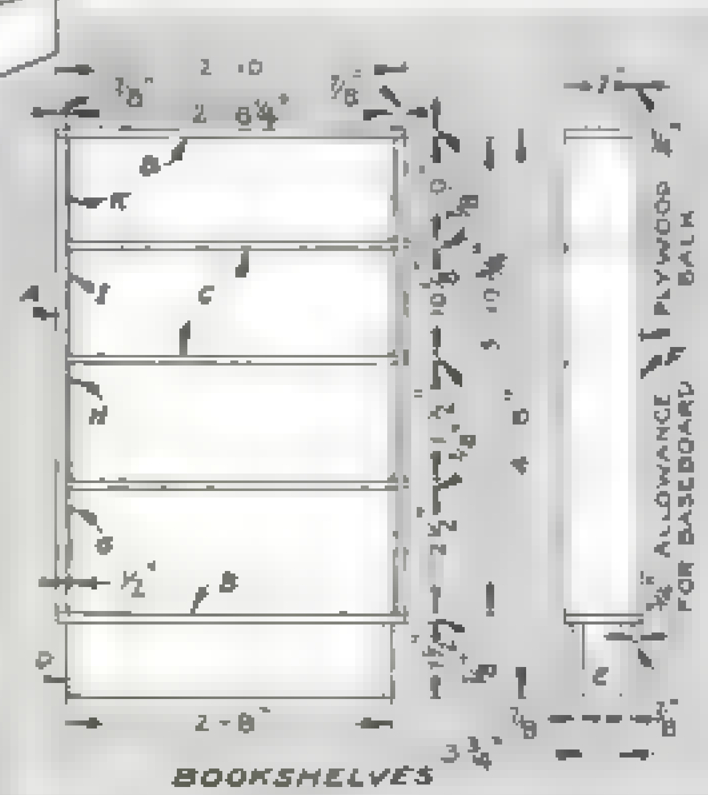


Fig. 6. The bottom section of the bookcase is stepped in to allow more toe room and to accommodate the baseboard.

BILL OF MATERIALS

No. of Pieces	Description	T	W	L	Mark
	Writing Desk				
4	sides	¾	12	25½	A
2	top and bottom	¾	12	44	B
1	plywood back	¼	25½	44	C
4	shelves	¾	12	10⅞	D
1	top	¾	20	54	E
4	blocks	2½	1½	16⅞	F
1	base molding	¾	2	45½	G
2	" "	¾	2	13½	H
	Library or Dining Table				
1	top	⅞	30	60	A
1	" plywood	¼	30	60	B
4	[illegible]	[illegible]	3	28	C
2	"	[illegible]	3	24	D
2	" "	¾	9	21	E
4	" fillers	¾	6	10	F
2	" "	¾	3	18	G
2	" "	¾	9	18	H
4	" plywood	¼	24	28	I
4	[illegible]	[illegible]	2	28	K
8	pieces of ¾ or 1-in. pipe,			31½	
8	lock nuts				
1	[illegible]				
	Chair				
2	front legs	[illegible]	[illegible]	[illegible]	A
2	rear "	¾	1½	31	B
4	cleats	¾	¾	[illegible]	C
2	side rails	¾	3	[illegible]	D
[illegible]	[illegible] rail	¾	3	[illegible]	E
2	side stretchers	¾	1	[illegible]	F
1	middle "	¾	1	[illegible]	G
1	plywood back	¼	3	[illegible]	H
1	seat	¾	16	[illegible]	I
	Deck Chair				
2	seat frame	[illegible]	2	41	A
2	back "	[illegible]	2	18	B
2	braces	[illegible]	2	22	C
2	dowels	[illegible]		20	
4	"	[illegible]		22	
1	"	[illegible]		24	
4	stove bolts			2	
12	washers				
16	roundhead screws, [illegible] in. No. 10				
1	canvas 20 in. wide and 50 in. long				
	Bookcase				
2	sides		7	[illegible]	A
[illegible]	[illegible] and bottom		7	34	B
[illegible]	shelves		7	32	C
2	front and back of base	[illegible]	7	32	D
2	ends for base	[illegible]	[illegible]	[illegible]	E
1	back, plywood		¼	58	F
2	fillers	[illegible]	[illegible]	2	G
2	"	[illegible]	[illegible]	1	H
2	"	[illegible]	[illegible]	[illegible]	I
2	"	[illegible]	[illegible]		K

Note. All dimensions are in inches

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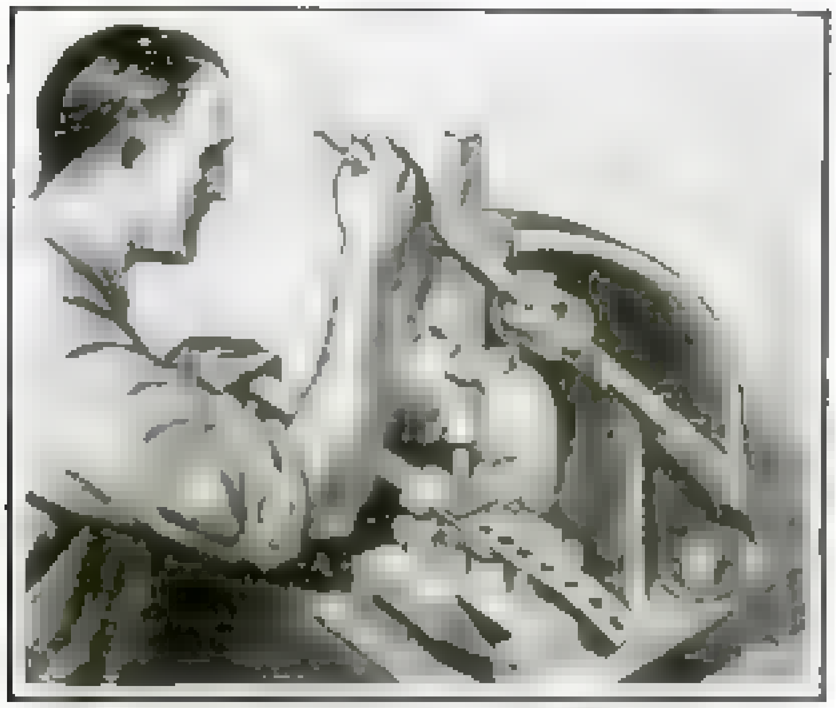
Pointers on Punching and Drilling Sheet Metal



Using a simple self-contained tool for punching holes in sheet metal. The construction is shown at *B*, *C*, and *D* in Fig. 1 below

By HENRY SIMON

ABOUT the simplest of all shop operations is that of putting a round hole through sheet metal. You have your choice of punching it or drilling it. And yet again—it may not be quite so easy. Presses have a habit of being tied up when you need them for smaller jobs; and for each size of punched hole, there must be a punch and a die. Drilling, on the other hand, is a difficult job if the metal is thin in comparison with the hole diameter.

Suppose, for example, you were asked to punch 100 holes each .005 in. in diameter in .001-in. foil—how would you do it?

If no other equipment is available, ordinary holes may be punched with the compact tool of Fig. 1. Small sizes may be made of solid tool steel as at *A*, but larger ones are best constructed from cold-rolled stock, with removable tool-steel die bushings and punches, as at *B*.

The tool at *B*, moreover, can be used for any smaller size merely by adding a punch and die of the desired size, similar to those at *C*. Note that the two body pieces are not doweled, but merely bolted together, to allow a "floating" adjustment, with a thin hard paper liner to prevent slippage. The data for making the tool are given at *D*, and an adjustable stock guide and working stop for use in a vise is illustrated at *E*.

At *A*, *B*, and *C* in Fig. 2, various ways of using these punches are suggested. By making the punch long enough and setting the tool up in a drill vise or a miller vise, it may be worked like a regular die in either a screw press or a punch press. By the addition of a rugged leaf spring *a* for the punch, it may be operated with a hammer or in a vise.

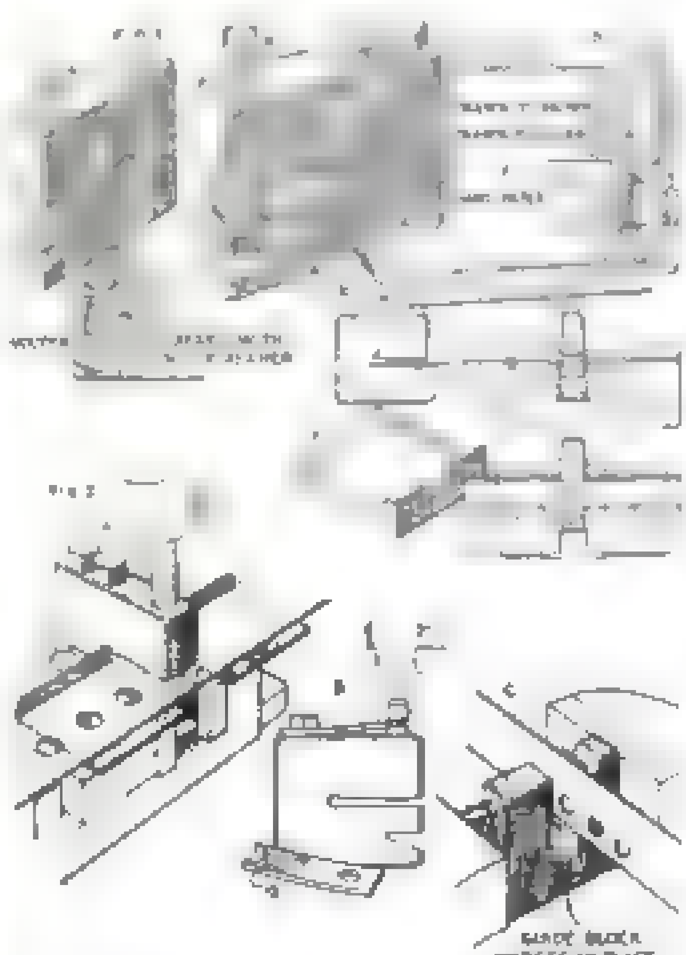
A heavy design, made from 2 by 2 in. cold-rolled steel and having a long reach which makes it suitable for perforating large sheets, is that at *D*. An easy way to square up the registering surfaces of the two jaw members in the larger tools is shown at *E*. The jaw member is held on a magnetic chuck and ground.

A STILL cheaper, though inferior, perforating die is seen in Fig. 3. This emergency tool is suitable only for very light-gage soft metal—say 1/16-in. or thinner mild steel. When the die *a* is worn, it can be reversed and the former stripper side used for cutting, while the old die side serves as a stripper.

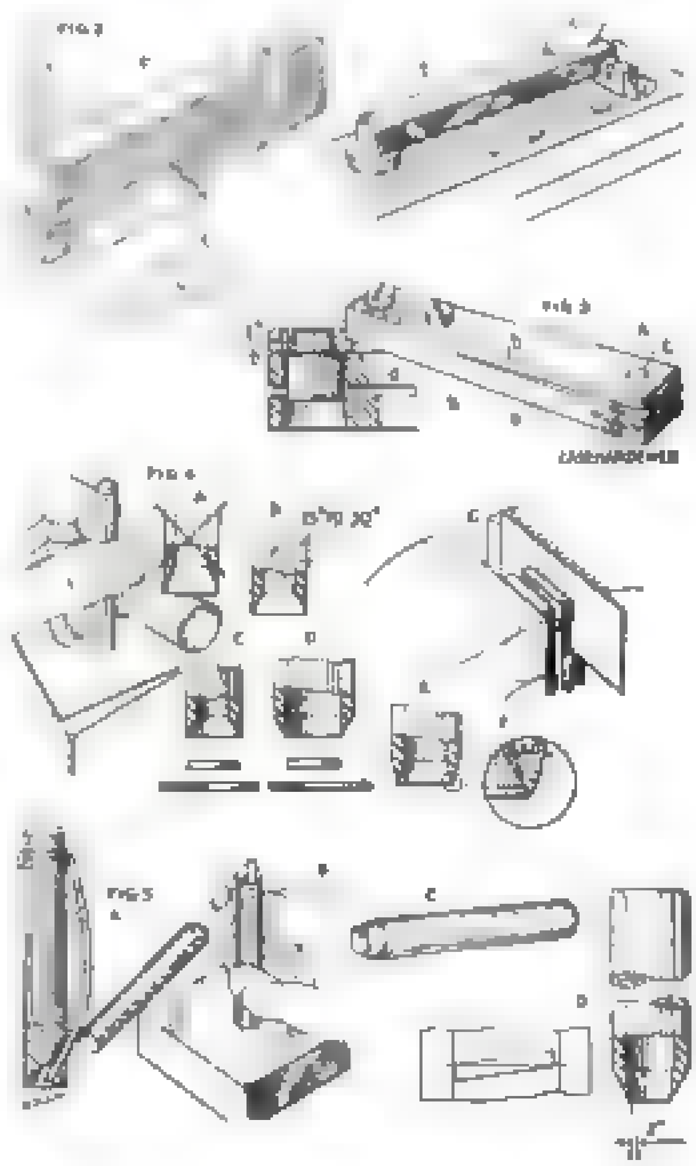
Where the metal to be cut is very thin and soft, as in the case of sheet copper, the easiest solution may be a hollow punch like that in Fig. 4, of the type used for perforating leather and paper. Avoid too sharp an angle on the cutting edge, as at *A*. The main or "blade" angle should be between 25° and 30° as at *B*, while the actual cutting edge should have an included angle of about 60°, as at *F*.

By shaping the blade as at *C* or *D*, either the hole or the blank will come out with a square edge, but a stronger construction is to center the edge as at *E*.

Where such punches are to be used a great deal, the question of how to get out the blanks becomes a major item. Simple and effective means to this end are shown in Fig. 5. The solid perforating punch at *A* employs a knock-out wire that ejects the blank upon being pressed by the fingers. With the hollow punch at *B*, the knock-out pin is set in a separate block, and the punch must be reversed each time, unless it is convenient to rig the knock-out pin overhead. The blanking punch at *C* receives the punchings in the barrel and discharges them through the top. Such a punch will be a success if it



Two types of punching tools and a guide and stop (Fig. 1), and various ways to use them (*A*, *B*, *C*, Fig. 2)



Wide-throat punch for large sheets (*D* and *E*, Fig. 2); a punch for very light work (Fig. 3); hollow punches and knock-outs (Figs. 4 and 5).

HERE..GLASS COMES TO LIFE

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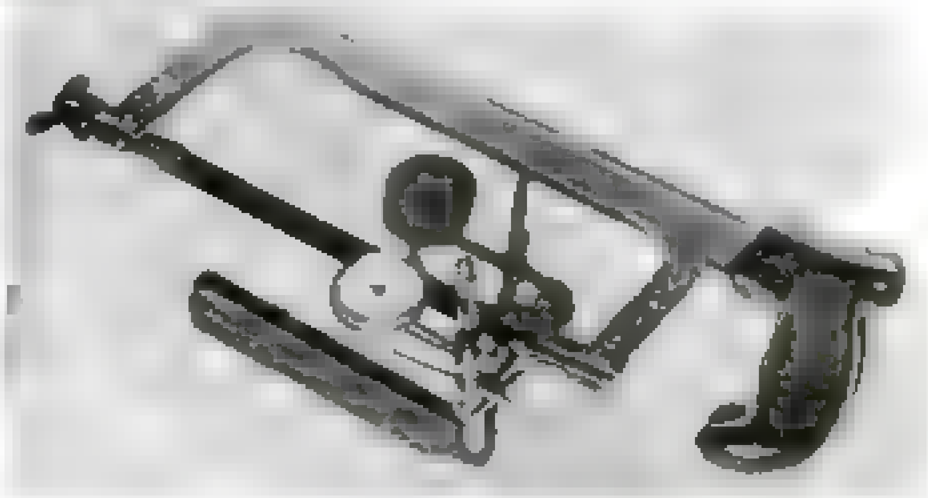

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is properly relieved inside as at *D*, and made stout enough.

The type of block on which such a punch should be used is a matter of great importance. Where sheet steel, spring brass, or bronze must be perforated, it is best to use a block of fine-grained cast iron such as in Fig. 6 at *A*. If the metal to be punched is very thin or very soft, as for instance steel foil of .005 in. thickness and less, or 1/16-in. soft copper, the materials indicated at *B*—brass, end-grain hardwood, or pressboard—may be employed.

THE difficulty of punching small holes in metal foil is solved with the help of sheet lead and solid punches in the manner illustrated at *C*. Clean-cut holes up to about 1/16-in. may be produced in this way, but only in very thin foil. The punch may be made from a sewing needle ground flat on the end and lapped in a block like that at *D*. A celluloid plate may be used for holding the foil flat.

Simple rigs for keeping punches aligned for the more important or difficult jobs are those at *E* and *F*.

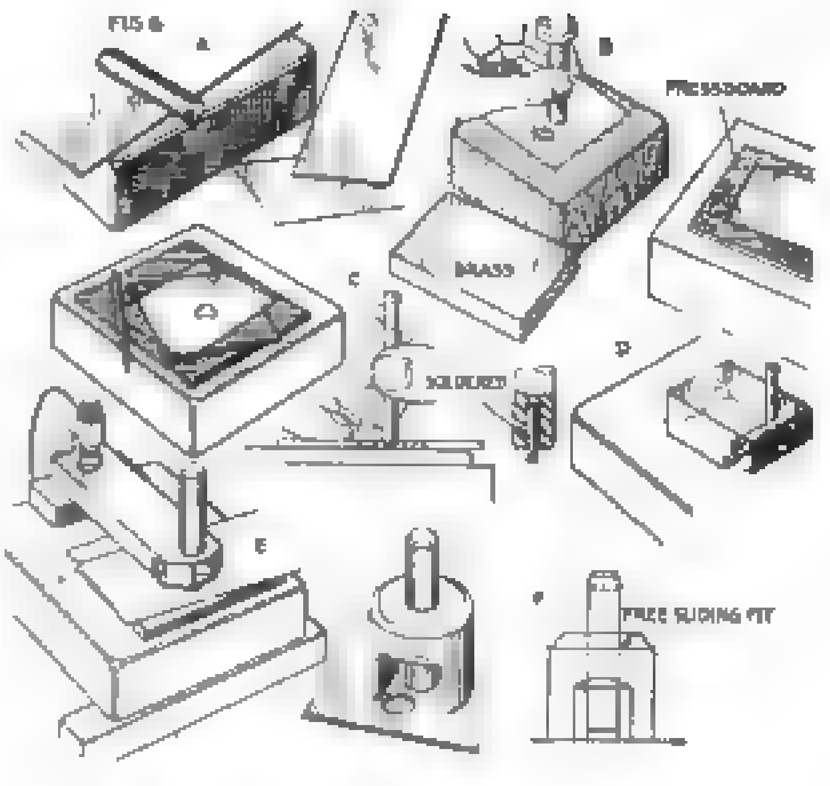
Producing holes by drilling has some advantages, but these advantages are often more than offset when the metal is thin in comparison with the drill diameter. A good rule to remember is that drilling thin metal in the ordinary way is generally satisfactory provided the metal thickness is not less than one fifth of the drill diameter, as suggested by diagram *A*, Fig. 7. By having solid metal underneath the work for the drill to pass into, much thinner metal may be drilled.

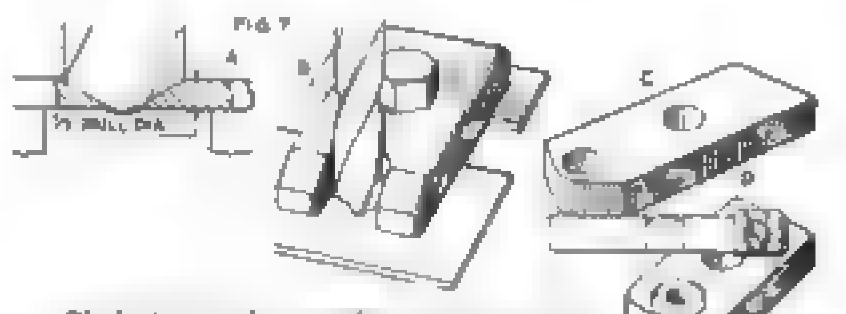
The work must be properly held down. *B* shows a cheap drilling strap which does not interfere with visibility. Where the metal thickness is much under one tenth the drill diameter, it becomes advisable to hold the metal firmly all around. This can be done by a closed clamp like that at *C*, with a hole of the same size as the drill being used. Where interchangeable drill bushings are on hand, a clamp like that at *D* often will be preferable.

METAL less than one twentieth of the drill diameter thick can be drilled either by putting it between two solid metal plates and handling the plates and sheet as one, or else by trepanning, that is, cutting only around the circumference.

An improvement over the ordinary "blind" way of drilling holes in this manner is that shown at *A*, Fig. 8, where a pilot hole through all three parts makes it possible for the work to be centered by means of a pin. A simple trepanning jig and the drill point for it are seen at *B* and *C*. Only the first method is suited for perforating a number of pieces simultaneously, as at *D*.

Large round holes several inches in diameter in metal of sufficient thickness—say not much under 1/100 of the hole diameter—can be made to advantage by employing a commercial hole saw or circular hack saw. At *A* in Fig. 9 is a homemade trepanning head for odd-sized holes of this kind. This tool uses common, straight hack saw blades. As will be noted from *B* and *C*, holes of different sizes can be produced merely by using the right size wedge ring and spacer, and the same ring may be made to do for a narrow range of sizes by employing a spacer block *a*.



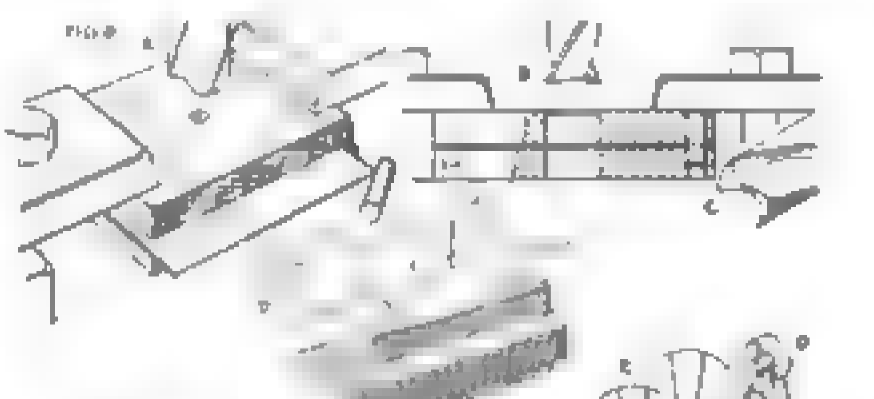


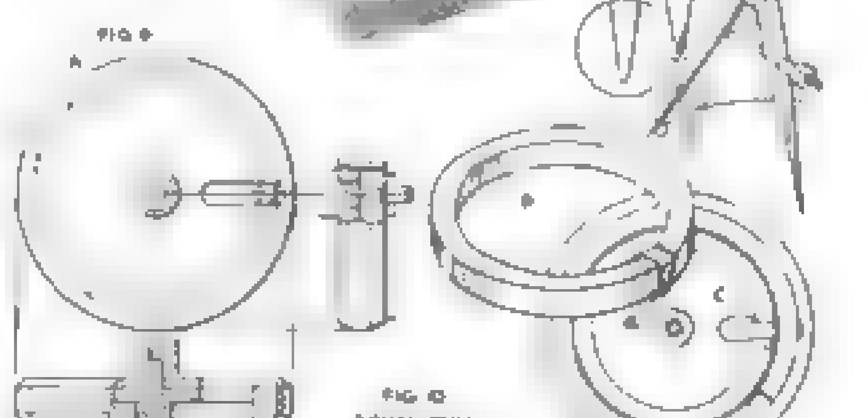
Blocks to use when punching various materials and two aligning fixtures (Fig. 6); hold-downs for drilling thin metal (Fig. 7).

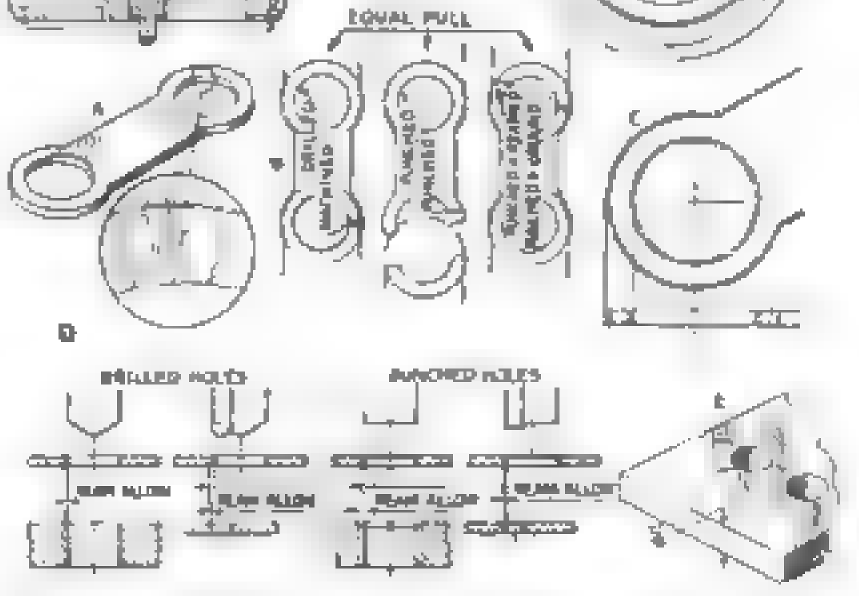
In very thin foil metals, large holes are best made with a machinist's compass or trammel, as suggested at *D*. The two kinds of points that will give satisfactory results are illustrated at *E*. One is an extremely sharp needle point, for use on hard metals, while the knife-edge point is best for soft material such as tin foil.

GENERALLY speaking, the *finish* of a hole will be satisfactory in foil and thin metal by drilling, trepanning, or punching. *Sizes* are, as a rule, easier to maintain in the thin sheet metals by punching than by drilling. The *strength* of the finished work remains the same in either case. In material from 1/16-in. up, size can be better maintained by drilling and reaming than by punching. Moreover, the strength when punched will be less if there is but little metal around the hole, as shown at *A* and *B*, Fig. 10.

This applies even more to steel parts which are to be hardened. Hardening strains, which always center around a hole anyway, radiate from the invisible hair cracks left by the punching and make a part like that at *A* entirely unreliable, unless an amount equal to at least about one fifth of the metal thickness has been removed from both the inside and the outside edges after punching, as at *C*. It should be particularly noted from *D* that this amount is not at all equal to the ordinary reaming allowance. Even where there is plenty of metal, as at *E*, punched holes are apt to be danger points in hardened articles if the metal is of any considerable thickness.







Drilling and trepanning thin metal (Fig. 8); methods of cutting large holes (Fig. 9), and comparison of punched and drilled holes (Fig. 10).

Hints for Men Who Work on Cars

Axle wedge stops shimmying. Rim spreader is easy to make. Door locks to guard children.

Popular Science Monthly awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Mrs. F. J. Fales, Lyons, N. Y., for her suggestion for a nail lock for rear doors (Fig. 5). Contributions to this department are requested especially from professional auto mechanics.

Fig. 4. With garage doors of unequal width, as shown, the opening and closing of them in high wind by one person is simple

SHIMMYING and hard steering often are due to a slight inaccuracy in the setting of the king-pin angles. If the king-pins are too nearly vertical, or the king-pins actually lean forward instead of backward, the wheels will not have the proper tendency to straighten out by themselves after rounding a curve.

Figure 1 shows a way to fit the axle to obtain more caster action. Thin wedge-shaped plates should be cut out and bolted between the spring and the spring seat on the axle with the thick end toward the rear. Sometimes only a slight change will make a big difference.

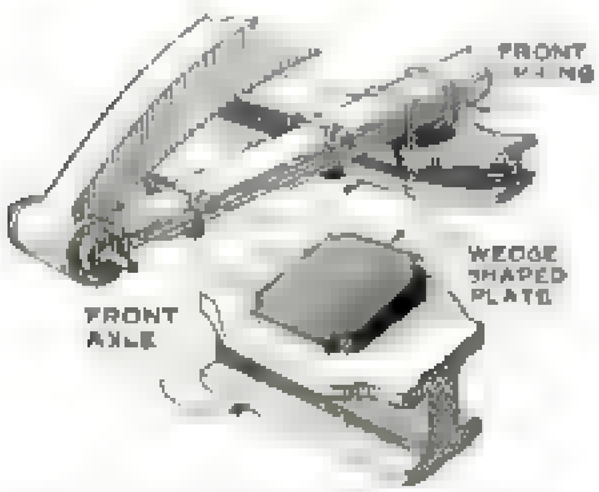


Fig. 1. Metal wedge, bolted between spring and spring seat on axle, will improve steering.

REPAIRING BRAKES

If, through wear or an accident, one of the connecting lines to a hydraulic brake leaks or is broken off, no pressure can be applied to the other brakes. Under such conditions, the temporary repair shown in Figure 2 will render the three remaining brakes operative. Remove the union. Place a leather washer and the head cut from a nail, as shown. This will seal the joint and allow pressure to be applied to the remaining brakes. This will serve temporarily and permit the driving of the car to a repair shop.

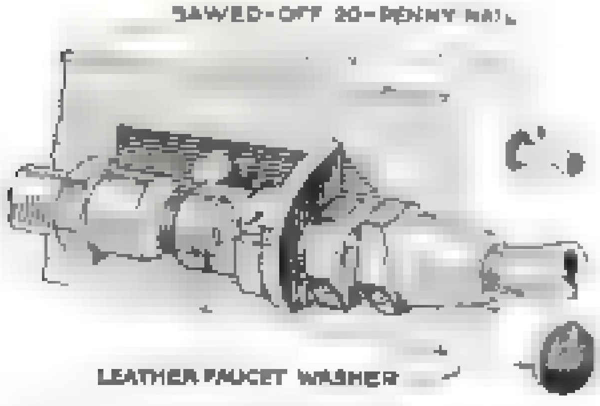


Fig. 2. A break in hydraulic piping can be fixed temporarily with nailhead and leather washer.

RIM SPREADER

The device shown in Figure 3 will prove serviceable in mounting tires on rims of various sizes. It consists, as shown, of a wooden platform in which three rings of holes are bored part way through. Four-foot lengths of iron pipe are strung together with a wire through holes in the pipe as shown and the top disk is notched to support the other ends of the pipes. By choosing the proper ring of holes it is possible to get a wedge which will spread any rim till it locks. The cost of a rim spreader of this type is low.

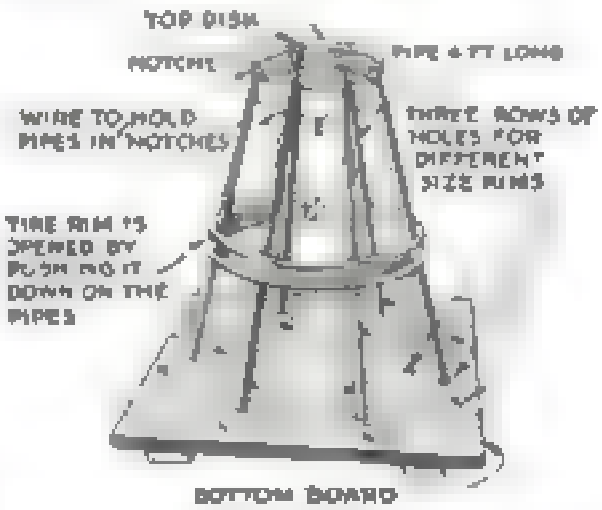


Fig. 3. Spreading a rim is made easy with this device of iron pipes and a wooden platform.

UNMATCHED DOORS

It is customary to make the doors of equal width on the ordinary twelve by eighteen foot home garage. With doors of this width it is necessary to open first one door and then go back and open the other one. If one door is made extra wide and the other narrow, as in Figure 4, time is saved because the narrow door can be pushed all the way open even in a strong wind, while a hold is still retained on the other.

An equal amount of time can be saved in closing the doors. Simply walk in with the wide door till you reach a point where the edge of the short door may be grasped and then continue in with both doors.

TWO LOCKS FOR DOORS

When children are carried in the back seats of cars fitted with four doors there is always a chance that one of the children may pull open the latch of one of the rear doors and fall out. Figure 5 shows two ways to prevent this trouble. The view at the lower left shows a strap arranged to hold the door latch in a closed position. The upper illustration shows a hole drilled through the door jamb and into the rear door large enough to receive a heavy nail which can be slipped into the hole. So long as the nail is in place the rear door cannot be opened. If possible, select a point for the hole where it will pass through the edge of the latch strike plate so that there will be no tendency for the nail to enlarge the hole.

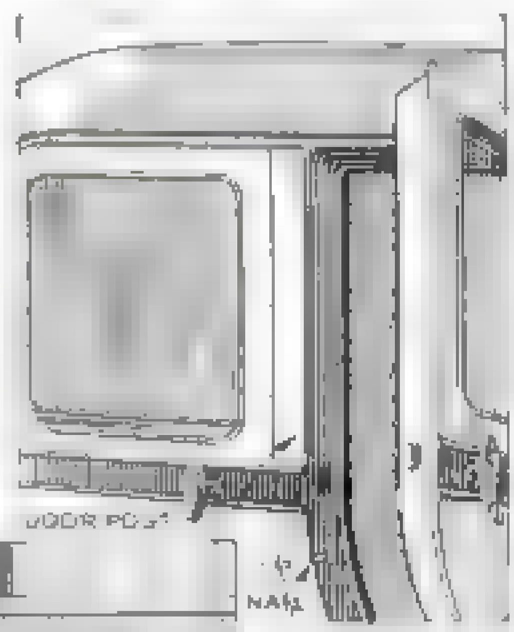
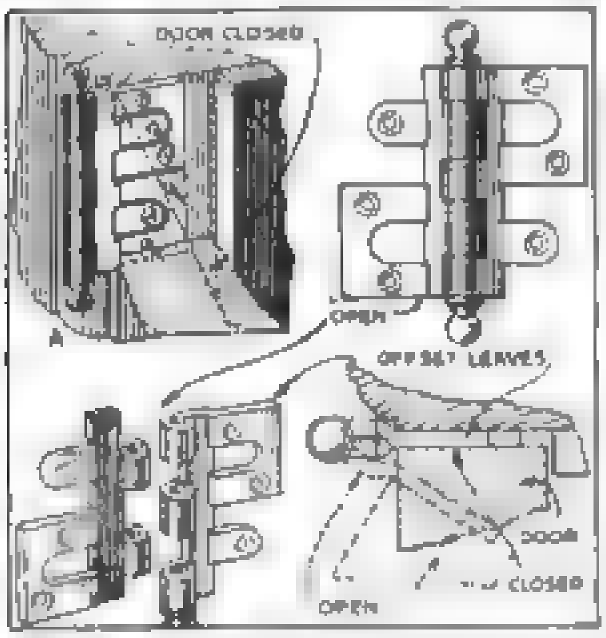


Fig. 5. Two ways of locking the rear doors so that children can't open them and tumble out. At left a safety strap does the job; above, diagram shows how a nail can keep the door secure

New Hinges Require No Mortises

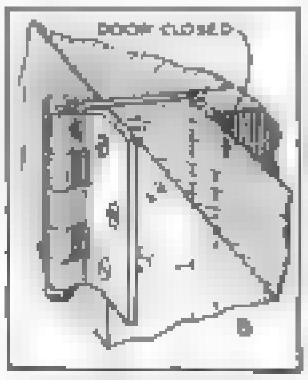
MANY amateur mechanics have learned by experience the difficulty of hanging doors, especially large ones, with ordinary butt hinges, because of the accuracy with which the hinge mortises must be marked and cut. Hinges are now available which have much the same appearance as regulation butts and yet require no mortising, they are therefore very easy to apply.

These nonmortise butts not only can be applied in much less time, but the manufacturers claim that they automatically insure alignment and a parallel hinge joint if the door is well fitted to begin with. Furthermore, there is no danger of marring door or jamb by a slip of the chisel, knife, or gage. It is also true that if it is ever necessary to change a door from right hand to left, or vice versa, there will be no mortise to be filled with an unsightly patch, if the screw holes are filled with putty or plastic wood, the repair will be practically invisible when finished.



The offsetting of the leaves form shoulders that bear against the door and the door jamb edges.

With this type of hinge the crack between the hinge edge of the door and the jamb cannot, of course, be any narrower than the thickness of the metal from which the hinge is stamped, but the hinges are purposely made as thin as practical.



Another type of hinge requiring no mortises

The available sizes of nonmortise butts of the type shown at *A* range between 2 by 2½ in. and 4½ by 4½ in. They are suitable for all inside doors.

Another type of hinge for use on light doors which also requires no mortising is shown at *B*. It is known as a "half-surface" butt. The jamb leaf is fastened in place in the rabbet of the jamb without mortising, the door is then wedged in place and the screws are driven through the face leaf into the door.—DAVID WEBSTER

By building the pool to suit the surroundings, the amateur gardener can make an attractive setting

A Rustic Rock Pool for Your Garden

By EMANUEL E. ERICSON

Director of Industrial Education, State Teachers College, Santa Barbara, Calif.

NO MATTER how small a garden may be, there is always room for a rock pool. Properly planned and set in a background of well-chosen plants, it is a source of joy to the owner and of admiration to his friends.

Pools may be round, elliptical, kidney shaped, or made to fit the contour around large boulders or trees. If the landscape is rugged and the garden built on natural lines, an irregular shape is usually better. Amateurs often make the mistake of following geometric forms when broken lines would be far more attractive.

It is not necessary to have an even depth in all parts of the pool, but if water lilies are to be grown, care must be taken to have the finished depth to the water line not less than 20 in. Excavate the ground, keeping in mind the fact that cement and rocks will be added over the entire surface.

Since this is to be a rock pool, no cement surfaces should be shown on the outside except in the joints. For this reason it is necessary to cut out enough ground around the edges for the first layer of rocks in the outer wall to come slightly below the surface of the soil.

Now is the time to put in the water pipe, unless the pool is to be filled with a garden hose. The ditch for the piping should be deep enough to extend below the frost line in cold climates. To lay the pipe and make the connections requires little plumbing skill, and practically none if flexible water tubing and fixtures are used. However, ordinary galvanized iron pipes can be used.

Where cold weather must be taken into consideration, a special stop and waste valve should be provided—one that will drain any part of the pipe which is above ground. Use lead paint or litharge and glycerin cement in all joints on the pipe, and test for leaks before filling the ditch.

The pool can be drained into a stone hole, or a cesspool if there is one handy. Should it be desired to keep the fountain playing for long periods, the drainage problem can be turned over to a plumber, who will be familiar with the local building code requirements and know whether a sewer connection will be permitted.

For the wall, rocks of various sizes should be used; if moss-covered ones can be found, so much the better. Take care not to scar the surfaces of those that will be exposed. Use a mortar of 1 part cement and 3 parts medium fine, screened sand. Any tight box will do for the mixing. Thoroughly mix sand and cement before adding water. A hoe is a good tool for mixing cement, but a shovel will do the work. Other tools needed are a stone hammer for trimming the rocks, a mason's trowel, a pick, and perhaps a crowbar.

Spread a 2-in. layer of cement mortar in the place excavated for the wall, and lay rocks upon this, having first washed them thoroughly. Keep in mind that the inside of the rock wall must later be plastered up to the water line with not less than 2 in. of cement. Avoid regularity in sizes of rocks and lines of the joints. Select the rocks for the outer wall in such a way that the upper edge will be nearly horizontal, and use a level rather than the eye to determine the general line. Put in a piece of pipe for overflow through the wall at the desired height, if a drainpipe with an overflow inlet has not been provided.

Scrape out the cement in the joints deeply enough to produce shadows; and before the cement is dry, brush some dry soil into the joints to obtain an aged effect.

The bottom of the pool and the inside of the walls are made from a mixture of 2 parts cement, 2 sand, and 2 crushed rock to which should be added some waterproofing which may be had from the firm selling the cement. Keep the mixture fairly wet [illegible] part of the [illegible] tamp it thoroughly. When the bottom has hardened enough so that it may be walked upon make up a stiffer mixture and plaster it upon the walls up to the water line.

After the surface has hardened somewhat make a wet mixture of 1 part cement and 1 part fine sand with some waterproofing and coat the entire inside. This can be applied with an old broom.

The bowl for the fountain can be made by pouring concrete in a hole cut in the ground

HOME WORKSHOP CHEMISTRY

WITH ordinary ink and a pen it is possible to write distinctly on glass. One advantage of this process is that the ink, being very dark, stands out strongly against the transparent glass. Sometimes the ink will take on unprepared glass without blurring, and this is especially true if the glass has been rubbed with the fingers or if it has been covered with a little saliva and allowed to dry.

A better method of writing on glass, however, is to provide a special undercoating for the ink. This may consist of

An example of the delicate ink linework that is possible on glass treated with Canada balsam.

Canada balsam dissolved in xylol (xylene)—about 12 drops of the thick, viscose balsam or 5 to 6 of the dry tears of balsam to about 1 oz. of the xylol. Apply this thinly over the glass. Within half an hour the varnish will be perfectly dry and ready to receive the ink.

Spar varnish also can be used with almost as lasting results. Dilute 1 teaspoonful of the varnish as it comes out of the can with 10 teaspoonsful of xylol, toluene, or gasoline.

These varnishes are excellent aids in preparing notices, diagrams, and cartoons on lantern slides. It is also an easy matter, when the smaller blank slides of magic lanterns have been prepared with this varnish, to copy cartoons, comic faces, and the like with pen and ink. Merely place the prepared slide, varnished side up, upon the drawing to be copied, and trace the lines.

Canada balsam varnish serves best for this purpose (the balsam and the xylol can be obtained in stores selling microscopical supplies). Prepare the slide by pouring the varnish on the glass, flow it on in all directions and let the excess drain back into the bottle.

Shellac varnish also can be used if it is diluted with denatured alcohol, but the results are not so good since the shellac is brown in color, flows on unevenly, and often presents a grain which is objectionable for projection.—H. Bade

Close-Limit Gaging on Milling Machines

By F. J. WILHELM

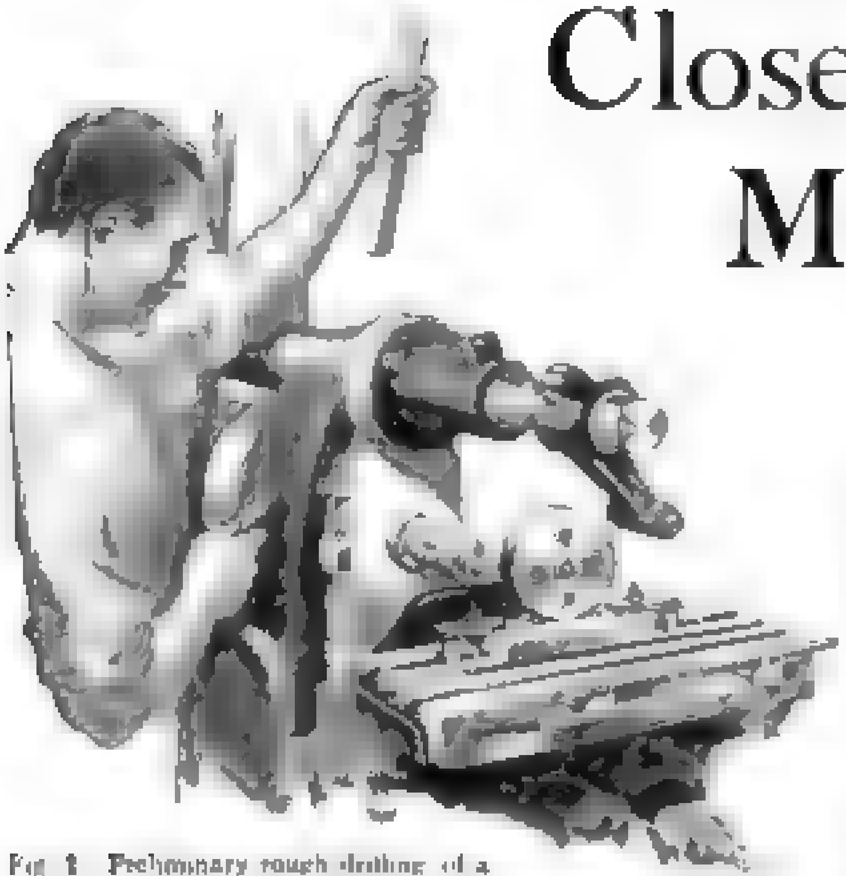


Fig. 1. Preliminary rough drilling of a hole before the accurate boring operation.

EVERY machinist and toolmaker knows that the graduations on the feed screw dials of ordinary milling machines and boring mills cannot be depended upon for the close limits desired on such work as boring jigs. If, however, the machine is in fairly good condition, it is neither difficult nor expensive to rig up an arrangement whereby the dimensions can be held as close as humanly possible, which is about plus or minus .0001 or .0002 in., provided the preliminary drilling and boring operations are done with the utmost care.

The attachments necessary to convert a milling machine into a jig borer are shown in Fig. 1. They are merely three brackets *A*, *B*, and *C* made as suggested in Fig. 2. Dimensions have been omitted because of the wide variety of machines upon which they can be applied.

The brackets should be fastened to the machine securely with cap or fillister head screws. The stop pin *D* in bracket *C*, Fig. 2, should be of suitable length and ½ in. in diameter, hardened and ground on the point.

Bracket *A* is furnished with a ⅝-in. rod of suitable length, so that the indicator may be adjusted up and down as necessary. Bracket *B* must be perfectly square with the table, and the dial gage must be mounted so that its needle is at the same height and in line with the stop pin in bracket *C*. The angle iron is bolted in the feed stop slot and locked in position.

To illustrate how the attachments are used, the simple piece of work shown in Fig. 3 has been chosen. This has five ½ in. holes equally spaced 1½ in. apart. The center hole is bored first. Dial gages are then set with 1.500-in. gage blocks between knee and gage and stop and gage. If the pins will not reach the blocks, additional blocks must be used. These extra blocks, however, only serve as an extension.

The machine locking devices should be tight. When about .002 in. pressure is applied on the dial gages and the hand is at zero, the 1.500-in. gage blocks are taken out and the knee raised so that the needle registers zero on the knee. Then bore the bottom hole. Next, lower the knee to allow a 3.000-in. block to slip under the gage and rest on the knee, or on the additional blocks if they were used in the first operation, and bore the top hole. Bring the knee to the central position with a 1.500-in. block in place and repeat the above operations by moving the table back and forth and by using the horizontal gage.

Assuming that care is taken in boring the holes and dial gages registering .0001 in. are used, accurate spacing is certain to result. And remember that the accurate job never comes back.

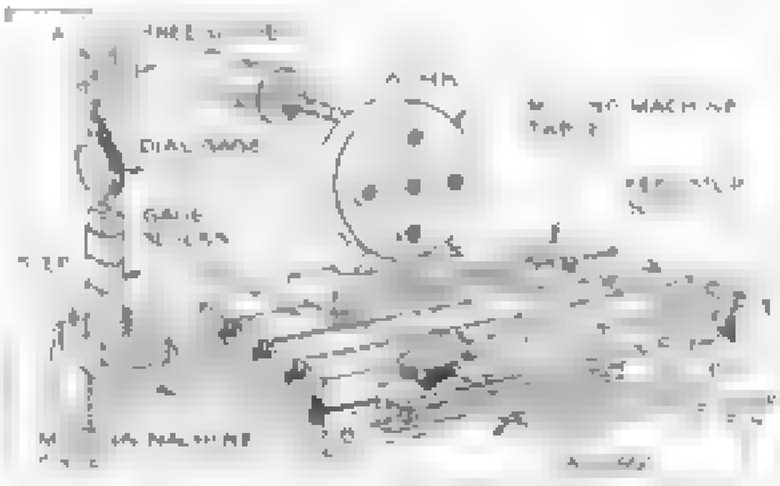


Fig. 2. Diagrammatic sketch of the arrangement of blocks and gages used to convert a milling machine into a jig borer.

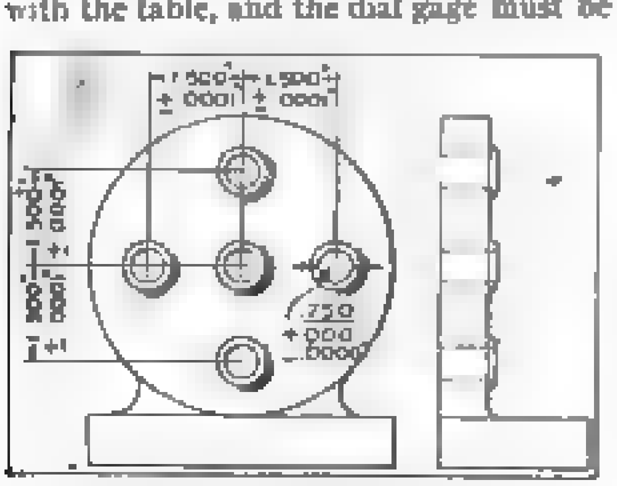


Fig. 3. With care, dimensions can be held to limits as close as plus or minus .0001 or .0002 in.

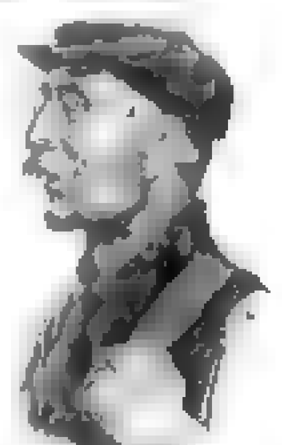
EASILY MADE CONTAINER FOR BLUEPRINT PAPER

THE problem of storing small quantities of sensitized blueprint paper becomes an easy one when you provide yourself with a suitable tube container similar to the one to be described. The tube portion of the container can be made from a piece of paper tubing such as furniture and rug companies use in rolling rugs for shipment.

Cut off a length of the tube somewhat longer than the width of the roll of blueprint paper. Next prepare two sheet metal caps for the ends of the tube. Tin cans, if cut off about 2 in. from the bottom, will serve nicely. Should it be difficult to obtain caps that will fit exactly, the diameter of the tube at each end can be built up with brown paper tape.

If desired, a colored lacquer can be applied.—Charles M. Rice.

Old Bill *Says*—



AN ANGLE plate gripped in a vise will serve as an excellent surface plate for small work.

Always drill and ream a hole at one setting, if it is possible.

Remove as much metal as you can with a drill and a power hack saw before placing the work in the miller.

Discarded phonograph needles fitted in suitable holders form ideal scribers.

Powdered rosin will prevent slip on an old, oily belt.

Never place heavy castings on the ways of the lathe.

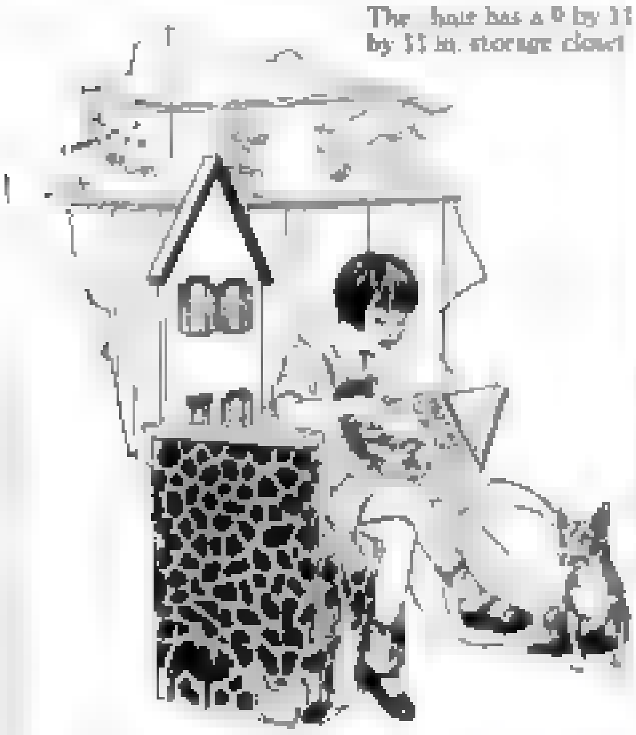
A little time spent in selecting the proper wheel in grinding operations will save time, money, and material.

For medium size bearings which have self-feeding oil cups, regulate the feed to about one drop per minute.

A Fairy-Tale Chair Amuses Children

REPRESENTING the little white house with the green shutters where the three bears lived and the scene of the familiar fairy tale, the chair illustrated forms both an attractive and durable piece of furniture for either the nursery, playroom or child's bedroom.

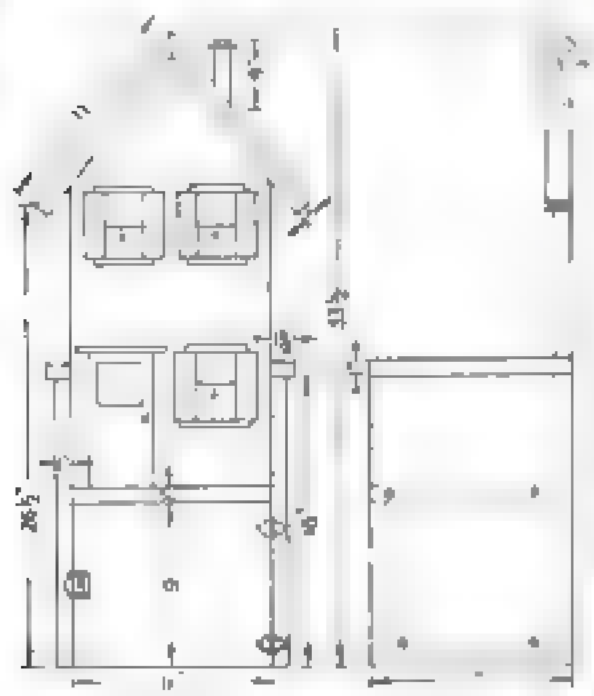
The stock, costing in its entirety about seventy-five cents, is ¾ in. thick and 12 in. wide. Blind stop is used for the roof


The chair has a 9 by 11 by 11 in. storage closet

eaves, chair arms, and chimney. The arm rests represent the coping on top of the garden wall. The figures used to decorate the base are made from cigar-box wood and can be cut to shape with a coping saw. If the worker lacks the artistic ability to draw the outlines, he can trace them from any book of children's stories.

Give the chair two or three coats of white paint and then outline the windows in black and paint the shades yellow. The shutters, which are not attached until the chair is painted, can be cut from stiff cardboard and finished in green.

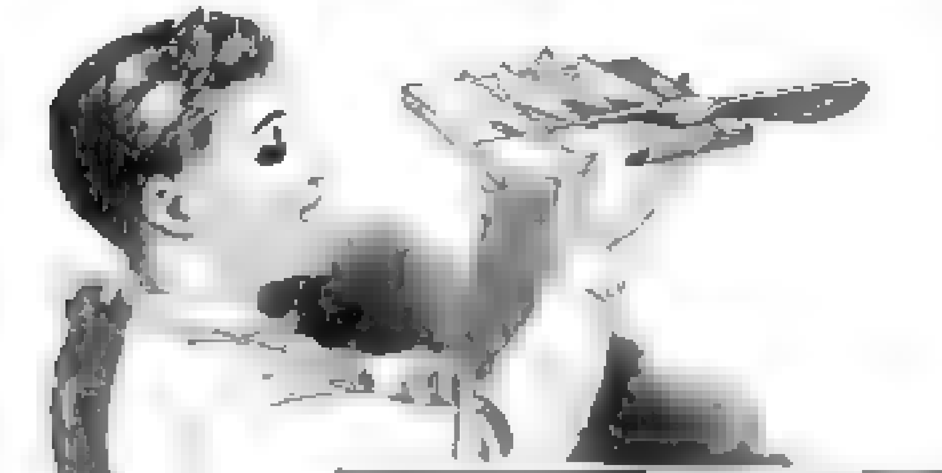
The wall effect is obtained by making irregular blotches of black on the white background.—DON HOUSEWORTH


Dimensions of the chair. The closet door is added after the chair has been assembled

You do not have to be an expert to design and make

True-Pitch Propellers

for Model Airplanes



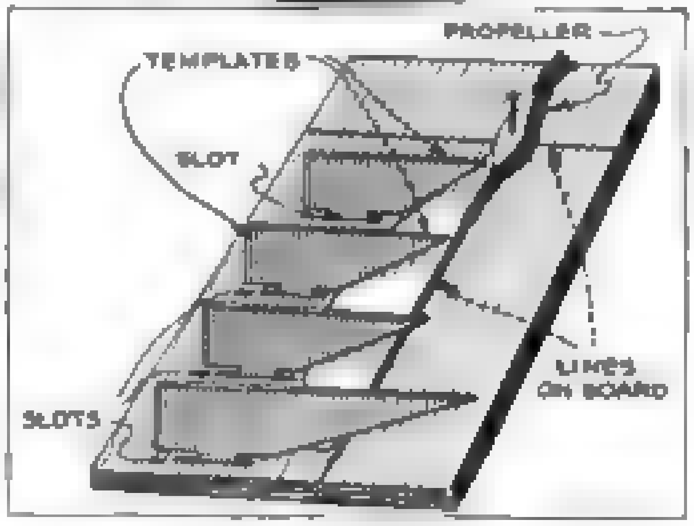


Fig. 1. The propeller is tested by placing it on the platform, moving the templates up against the blank, and sighting along the blade.

By EDWIN T. HAMILTON

FEW model builders, if I may venture an opinion, have mastered the art of designing and cutting true-pitch propellers. On recent inquiry, I find that this is due to a mistaken belief that no one but an aeronautical engineer can understand propeller mathematics. This article is written in the hope that it may abolish this belief.

Three main factors must be considered in the shaping of a true-pitch propeller:

1. The theoretical pitch of the propeller.
2. The desired width of the blade of the propeller.
3. The necessary size of the propeller block.

The theoretical pitch of the propeller is the distance it would travel forward in one revolution if operating like a screw in solid material. This is found by the following formula:

$$\text{Theoretical Pitch} = \frac{D \times \pi \times T}{W}$$

where D = the length of the propeller block, π = the constant 3.1416, T = the thickness of the propeller block and W = the width of the propeller block.

For example, if a block measures 1 by 1½ by 11 in., the formula would read:

$$\frac{11 \times 3.1416 \times 1}{1\frac{1}{2}} = \frac{34.5576}{1\frac{1}{2}} = 23.03 \text{ in., theoretical pitch.}$$

Figure 2 shows the first step. On a sheet of paper—cross section paper will be found best—draw a horizontal line which is as long as the circumference of the circle made by the tip of the propeller in one revolution. In other words, it represents the length or diameter of the propeller multiplied by the constant 3.1416.

From the hub point and perpendicular to the circumference line, draw another line, which must be as long as the theoretical pitch of the propeller being designed. These measurements must be exact, but can be drawn to scale if desired. Divide the circumference line into four equal parts and draw lines from these division points to the upper end of the pitch line. These lines form with the base line the correct angle to be cut at each of their respective positions on each blade of the propeller.

Now block out the templates, as shown, and mark each according to its position along the propeller blade. Cut out each of them, trace the outline on tin or stiff cardboard, and cut the finished templates, which will appear as in Figs. 1 and 2.

The next step is to prepare the soft wood platform. This should be slightly longer than the radius of the propeller. A line is drawn the length of the board, and another line at right angles to it. A pin is to be thrust through the propeller shaft hole and into the board at the point where these two lines intersect (see Fig. 1).

Shape the propeller as desired and cut the blades down until they are about ½ in. thick. Now, place the propeller on the platform and trace its form with pencil on the board. Draw lines at right angles to the long line, as shown in Fig. 2, dividing the radius of the propeller into four equal lengths. With a razor blade, cut these lines through the board, but be sure that they are not longer than twice the width of the small flaps on the templates. Again lay the propeller in place, slip the flap of each template into its respective slot, and push it up to the edge of the propeller blade. Be sure that the bottom edge of each template is resting on, and is parallel to, the top of the platform.

Figure 1 shows the finished platform, with each template in place, and the propeller shape being tested.

As the blade is cut thinner, the templates must be moved up, so that the angle at each point will remain correct. More templates can be used, if desired, simply by drawing more lines forming more angles and fitting the added templates into the platform at their respective positions.

Such templates and platform, as described here, may be kept for future use but the model builder must bear in mind that they can be used for one size of propeller block only.

Great care should be taken to see that the platform is perfectly level at all points and that the bottom edge of each template is straight along the base line.

In his next article, which is scheduled for early publication, Mr. Hamilton will give suggestions for competing in model airplane contests.

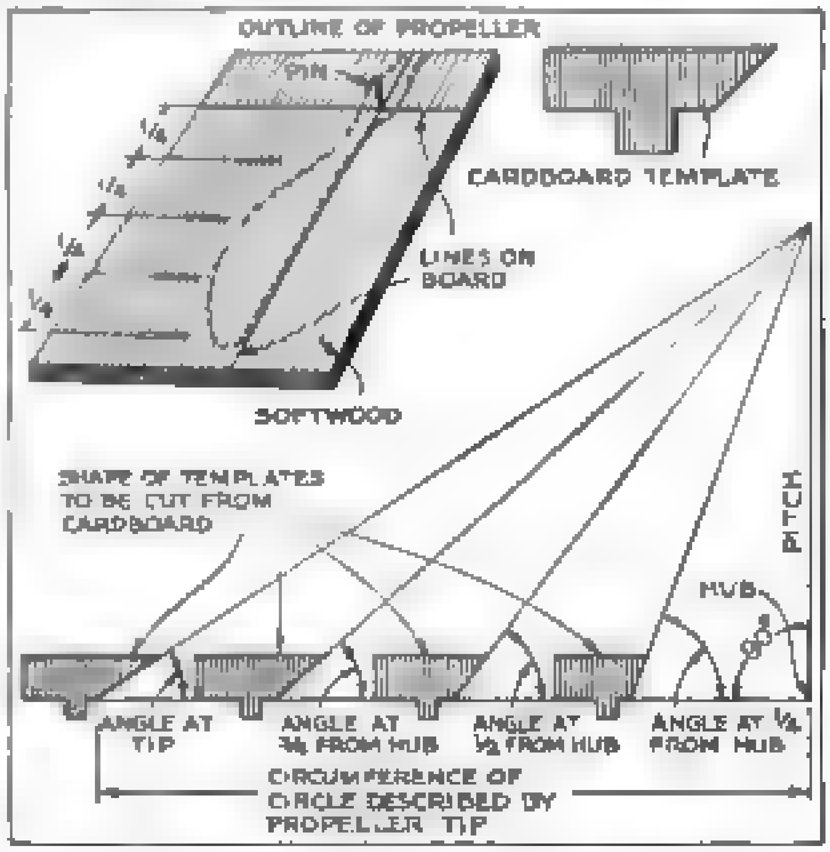
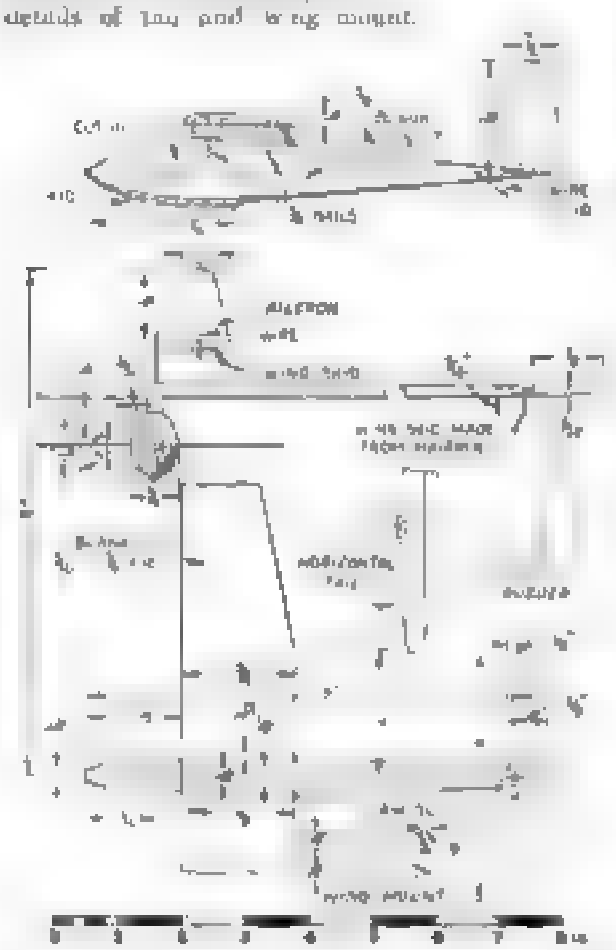


Fig. 2. How the angles are obtained. The templates derived from one set of dimensions can be used only on blocks of that size.

Whittling a Bowlus Sailplane Model

BECAUSE of the keen interest displayed everywhere in the sport of gliding, a Bowlus sailplane has been chosen for the subject of the fifth article in the present series on constructing simple, nonflying models of modern planes. There are so few parts that the model should not be difficult for anyone to make, yet when neatly finished and carefully painted, it will be a unique and worthy addition to the models previously

Assembled views of the plane and details of tail and wing mount.



described (see P. S. M., Apr. '30, p. 110, May '30, p. 124, June '30, p. 95, July '30, p. 76).

The fuselage is whittled from a soft white pine block ¾ by 1¼ by 7 in. The cockpit is cut into the fuselage as shown with a small chisel. Just behind the cockpit is placed a small block ⅛ by ⅝ by 1⅛ in., rounded at the rear as indicated; this forms the wing mount.

The wing itself is cut from a blank ⅛ by 1¼ by 16 in. The ailerons are cut off after the wing has been shaped, and then each is pivoted in place as shown by means of a single headless brad or a short length of wire. Two thin ¾-in. brads are driven right through the wing and the mounting block into the top of the fuselage.

A narrow strip of wood is glued beneath the front part of the fuselage to form the main skid. The tail skid and the wing skids are made from hairpins or thin wire. The tail units are cut from thin metal, the rudder being slotted to interlock with the stabilizer, and both are inserted in slots in the rear of the fuselage, where two brads hold the assembly in place.

The colors suggested are: for the fuselage, dark blue; for the wing and tail, light blue; and for the three skids, black.—DONALD W. CLARK.

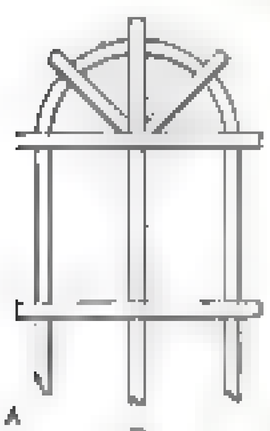
Easy-to-Build Garden Trellises

Ten Suggested Designs That You Can Construct Easily at Trifling Expense

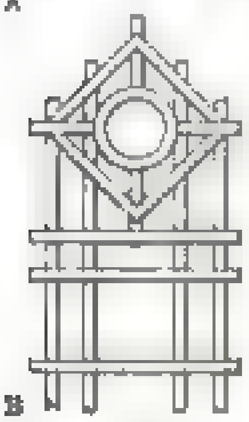
By
GEORGE VAN WALTHER

BY USING the ten ornamental trellis designs shown as a basis for construction, the home worker should encounter little difficulty in supplying his garden with a variety of fences, screens, and attractive supports for climbing vines, flowers, and shrubs.

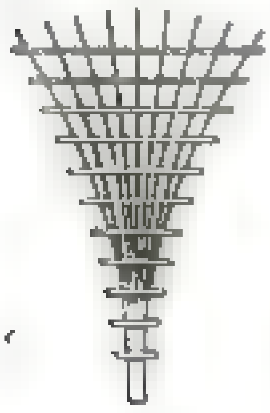
The most common types of trellises and the easiest to build are shown at *A*, *B*, *C*, *E*, and *F*. These can be made with or without the use of dadoed (grooved) joints, as nails or brads will be adequate fastening for the latticework. This form of trellis is generally placed against the house, garage, or garden wall, where it serves to ornament what otherwise may be an unattractive expanse of brick, stucco, or wood.



A



B



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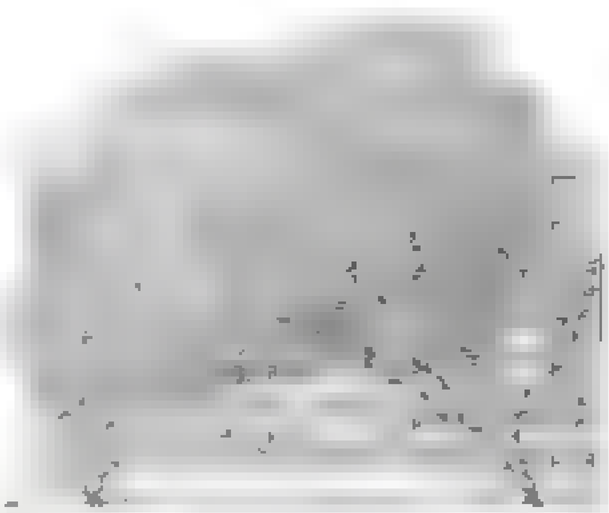
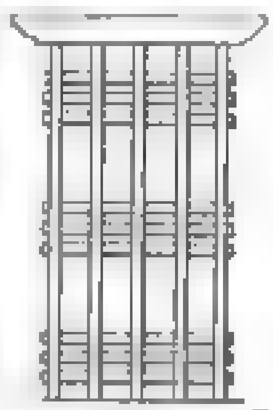


Fig. 1. A trellis that serves well as a background for a fountain, rock pool, or formal flower garden

At *D* is shown a trellis of slightly different design, since it is topped off with a pergola beam. This type can be set up in the garden as a background for a fountain or pool and if made longer can be used as a back fence or as a screen to separate the children's play yard from the rest of the garden. The design shown in Fig. 1 will also serve the same purpose, while that shown in Fig. 2 is especially suited for inclosing some portion of the garden.

Trellises can be made from pine, cypress, western cedar, or fir, ⅜, ½, ¹³⁄₁₆, or 1⅛ in. thick and ¹³⁄₁₆, 1⅛, 1⅝, 1⅜, 1¾, 2⅜, or 2⅝ in. wide. In some localities it may be difficult to obtain this wide choice of stock but a suitable size can generally be found. Indeed, it is often possible to find sufficient lumber in the scrap heaps around new buildings to supply the average size garden with all of the trellises required.

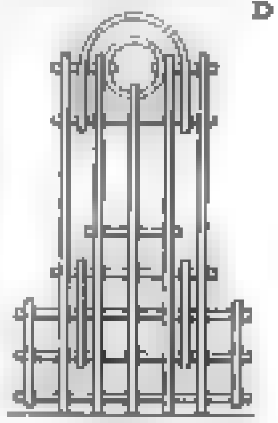
Archways such as shown in Figs. 2 and 4 will add much to the attractiveness of winding gravel or flagstone paths. The form in Fig. 4 is, of course, the simpler of the two, but the added beauty of that shown in Fig. 2 will more than repay one for the additional work if the garden is large enough to accommodate it. Larger sizes of lumber should be used in these constructions and also for the garden seat shown in Fig. 3.



D

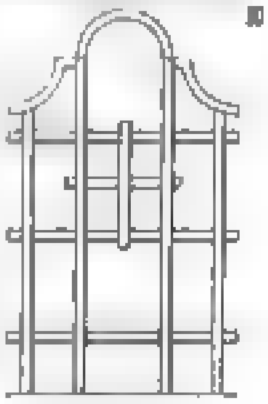
While ordinary nails and brads will serve for the smaller trellises, the use of galvanized nails and brass screws is recommended wherever practical.

Trellises are generally painted with a white, cream, or green paint made with white lead and oil, but attractive results can often be obtained through the use of a stain or shingle creosote mixture, since the trellis can then be colored to blend with the background. If your woodwork is painted with a priming coat before it is assembled and then with two additional coats after, with an occasional repainting, your garden woodwork should last for many years without repair. The grade and kind of lumber, of course, has much to do with the wearing qualities of the finished pieces.



E

Scale drawings of three attractive garden trellises and a sundial stand are included in Popular Science Monthly Blueprint No. 34, and full plans for the construction of a combination garden gate and arbor with two seats are contained in Blueprint No. 9. Both of these have complete bills of materials and can be obtained for twenty-five cents each from the Blueprint Service Department.



F

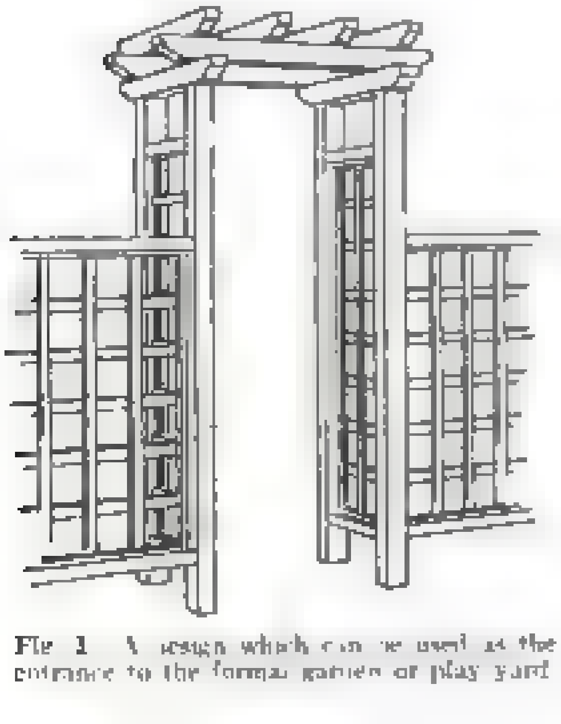


Fig. 2. A design which can be used as the entrance to the formal garden or play yard

Fig. 3. When covered with vines this garden seat will prove a decorative and comfortable addition to the flower garden.

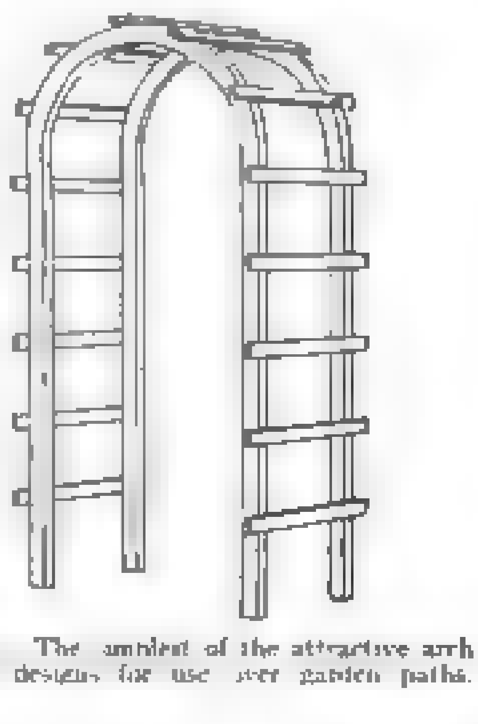


Fig. 4. The simplest of the attractive arch trellis designs for use over garden paths.

THE SHIPSHAPE HOME

Hints on Making Many Varieties of Shelving

TO CONSTRUCT the best type of shelving for any special purpose, the handy man must be familiar with a wide variety of designs. Suggestions are therefore given in this article for building a bookcase of a superior type, with or without doors, and for making adjustable, skeleton, and hanging shelves. These hints complete the discussion of shelving which began in the preceding issue (P. S. M., July '30, p. 113)

What is the best way to construct a bookcase?

The grooved and fitted shelves shown in Fig. 1 is the type of construction commonly used upon the better class of bookshelves.

1. Note that each groove stops ¼ in. from the front of the end as at *A*, and that

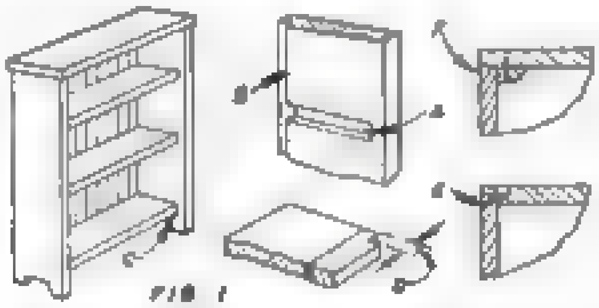


FIG. 1

How grooved shelves are assembled and two methods that can be used in attaching backs.

each shelf is ¾ in. narrower than the end to allow for the ½ in. sheathing back which fits into the rabbet *B* at the inside back corner of each end and also that each shelf is held back ¼ in. from the front edge of the end as at *C*. Plywood may be used in place of sheathing.

2. Clamp all the shelves together, as suggested last month, and cut the corner shoulder *C* from the front edge of the shelves while they are thus held; this will insure a uniform length. The distance *D* should be a little less than the depth of the groove or dado in the end pieces to insure a tight joint against the end. (The dadoes are cut as described in the preceding article.)

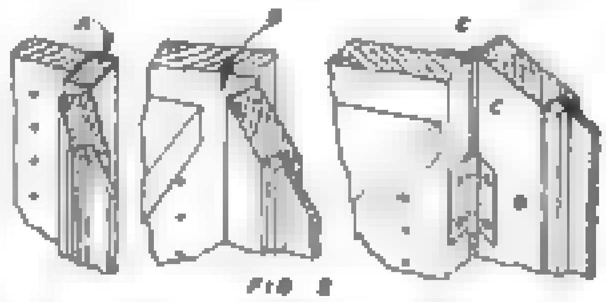
3. If the back is made of sheathing, the boards are nailed to each shelf and fastened in a rabbet in the top as at *E*, or against a batten nailed to the top as at *F*. The bracing effect of the back will hold the case square. A back of ⅜-in. plywood may be used if available. Being in one piece, it is the best back for a bookcase of this type. If plywood is used, the width of the shelves must be correspondingly greater.

4. If hard or expensive wood is used and it is desired to save expense and make

the bookcase lighter, narrow face strips of the wood may be glued to the front edges of shelves made of pine or other light wood of common quality. The cheaper wood will be covered by the contents of the shelves, and only hardwood on the front edges will be visible (see view in center of Fig. 1)

How may doors for a bookcase or other shelving be built?

In the first place, the case itself should be designed for hanging doors. If the doors are to be hung from a casing as at *A*, Fig. 2, the shelves may be grooved the



Three different arrangements which can be followed in the hanging of bookcase doors

entire width of the end because the ends of the dadoes will be covered by the casing. The bottom shelf should extend to the face of the casing.

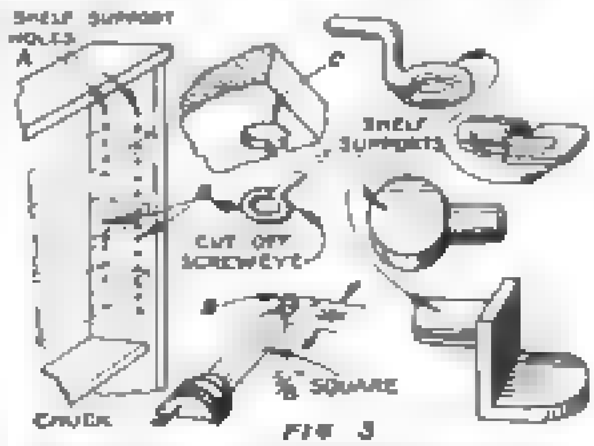
The casing should be glued and fastened with finishing nails, or held by dowels, if the best work is desired.

When the door is to be hung between the ends as at *B*, the shelves should be no wider than will allow the door to close easily. The door may be hung upon the face edge of the ends as at *C* with the hinges hidden in the joint as indicated at *D*, which is the conventional method. An easier way, but far less desirable from the point of view of appearance, is to place the hinges upon the surface as at *E*, no mortising being necessary.

What are some simple methods for constructing adjustable shelves?

Often one wishes that a rigidly built shelf could be raised or lowered a little. And there is no valid reason why a bookcase with a back to keep it square, or one that is otherwise well braced, should not have adjustable shelves. Indeed, there is a distinct advantage in the fact that it is not necessary to make close fitting dadoes for the shelves.

1. The common method is to bore a series of holes to receive shelf supports. These are placed as shown at *A*, Fig. 3. Several such supports are also shown



The usual method of building adjustable shelving and five types of movable shelf supports

Stout eyes may be used in place of regular supports as suggested at *B*. Bore a shallow hole in the bottom side of each corner of each shelf as at *C*, to receive the ring of the screw eye and prevent the shelf from slipping forward.

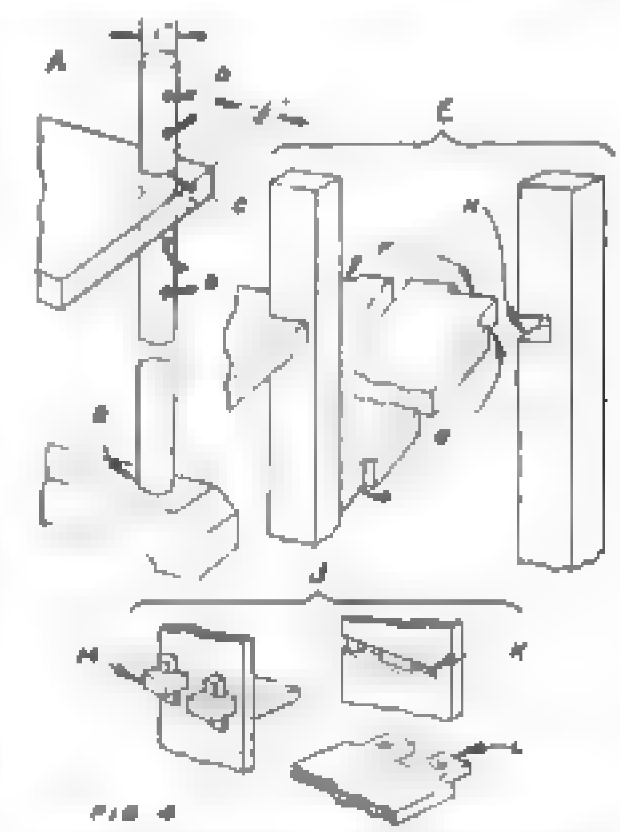
2. The holes for shelf supports, of whatever variety, should be placed accurately from 1 to 1½ in. apart in straight and parallel lines about 1 in. from the edges of the shelf. Mark the centers with a scratch awl to insure precision in boring. Each line of holes should begin about 7 in. from the bottom shelf and be spaced with care so that each shelf will rest evenly and firmly on all of its four supports.

3. To make certain that these holes are not bored through the end, use a bit stop or make one. This can be done by putting a ¼-in. drill—or whatever size is required—in the hand or electrical drill and drilling a hole lengthwise through a piece of wood about ⅜ in. square. Cut it off, allowing about ½ in. of the drill to project as at *D*.

When shelves of the skeleton type are required, how may they be built?

1. A simple method of building a light but rather frail shelf of this kind is shown at *A*, Fig. 4.

Glue four 1-in. diameter or smaller dowels firmly into two bases or feet as at



Three forms of construction that are commonly used in making the skeleton type of shelving.

B and bore holes of the same diameter as the dowels in each corner of each shelf as at *C* to coincide with the four dowels. The bottom shelf may be fastened to the feet with glue and nails for greater strength.

The shelves may be fastened to the dowels by driving nails through the edge of each shelf into the dowel, in which case a ¾ in. diameter dowel will answer the purpose. Light wires stretched diagonally across the back and fastened to the shelves with double-pointed tacks will add much to the stability of the case.

The shelves may be made adjustable by boring a series of holes spaced exactly

the same in all four dowels, as at *D*, and inserting a pin to support the shelves.

2. The method of building a skeleton shelf indicated at *E*, Fig. 4, is well adapted for the construction of a music or magazine rack. It makes a strong and rigid set of shelves, open on all sides. Considerable skill, however, is necessary in fitting the shelves and legs because the distances between *F-F* and *G-G* of each shelf must be the same upon all shelves. Also, the mortises *H* in the legs which support the shelves must be carefully located so that each shelf will rest parallel with the others. The mortises should be cut closely to the thickness of the shelves, for upon the strength of these corners depends the rigidity of the case. The shelves should be clamped together and all corners marked and notched at one time to insure perfect alignment.

3. The type of construction shown at *J*, Fig. 4, was popular during the reign of "Mission" furniture during the first decade of this century. Certainly it has strength to commend it, for a set of shelves built by this method should last as long as the wood itself unless destroyed by inexcusable abuse or fire.

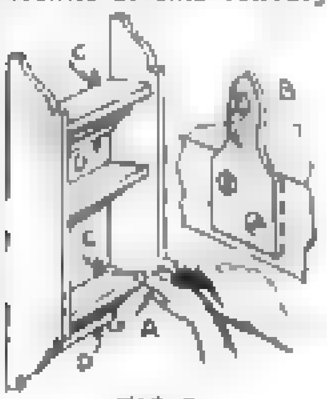


FIG 5

Hanging shelves and ways to support them

Its construction is the same as that shown in Fig. 1 except for the mortises *K*, the tenon *L*, and the wedges placed as at *M*. Of course, the shelves should be made of the same kind of wood as the ends.

How may hanging shelves be made and hung?

The construction and bracing of hanging shelves is not essentially different from shelves standing upon the floor or supported from the base. Since, however, the shelves are supported on the wall, the bottom of the ends may be shaped to some design, as *A*, Fig. 5. Usually the shelves are not more than 6 in. deep.

The case may be supported by brass "mirror plates" cut into the back edges of the shelves as at *C* and *B*. Screws are driven through the plates into the wall as at *C*. If backboards are used, the shelves can be hung by means of screws *D* instead of the "mirror plates." Be sure, however, that the screws enter the wall studs—not merely the laths.

How are shelves finished?

They may be treated with stain, shellac, varnish, paint, enamel, or lacquer as desired. It is usually desirable to observe economy of both material and labor, hence, after the first coatings, it is not necessary to rub or to polish more than about $2\frac{1}{2}$ in. in from the face of the shelves and of the inside of the ends between the shelves. Rarely is anything more done to the bottom of the shelves than to make them of the color tone of the rest of the case. —C. A. K.

There's an Air Mattress Hidden in This Sleeping Bag

Fig. 1. In use, the bed and hood form a complete covering which insures protection from wind, cold, and dampness of the ground.

By L. C. NODERER

SUCCESS and pleasure in camping depend upon carrying the largest amount of comfort in the smallest and lightest bundle. That is why the sleeping equipment presents one of the most stubborn problems. Ordinarily, it is necessary either to take a cumbersome outfit which includes a folding bed, mattress, bedding, and tent or to go to the other extreme and sleep on the hard ground, unprotected from the elements. The former is too much bother for the ordinary overnight camp, and the latter well, most of us are fond of comfort.

A highly satisfactory solution may be found in a homemade combination sleeping bag and air mattress. Easily and inexpensively assembled, this air bed is tent, folding bed, mattress, and bedding roll, all in one. To make camp, all that is necessary is to unfasten the bed from the running board, unroll it with a flip, put three or four lungfuls of air in each tube, adjust the hood, and the bed is ready for use as in Fig. 1, the time required being a matter of a few minutes.

As the bed may be strapped to the running board by means of "coachman loops," it makes a compact, convenient, and easily carried bundle which does not detract from the appearance of the car (see Fig. 2).

While an air bed designed to accommodate a single person may be made, the following list of materials is for a double bed: 5 yd. of 22-oz. canvas 64 in. wide and 2⅓ yd. of 10-oz. canvas 64 in. wide, not waterproofed, 12 brass grommets, 24 ½-in. snap hooks for patent fasteners, 24 ½-in. galvanized rings, 10 inner tubes (29 by 4.40 or thereabouts), ¼-pt. can of rubber cement, and 1 spool of heavy white linen thread.

Fig. 2. *Oval:* The entire bed rolls up into a small bundle.
Fig. 3. *Above:* Blankets or wool quilting form the bedding.

These materials cost the writer fifteen dollars, but this included a three-dollar charge for sewing.

If the main canvas is first marked as in Fig. 4, it will facilitate the sewing and assembling, whether you do it yourself or have it done by an awning maker. At each end of the 22-oz. canvas a 1 in. hem is made to prevent raveling. The selvedge will not need a hem. At right angles to the selvedge, lay off two lines, one 6 ft. 4 in. from one end, the other 12 ft. 8 in. from the same end. This will divide the piece into three parts; the cover flap, the bottom of the bag, and the head flap

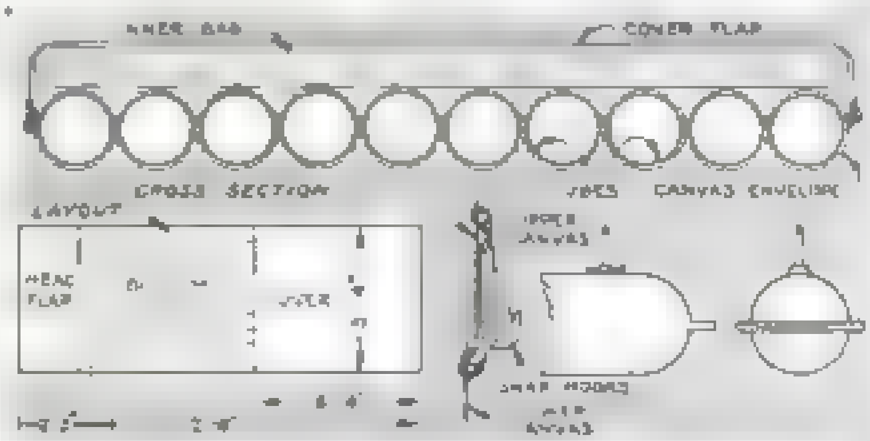


Fig. 4. A cross section of the bed, plan for laying out the canvas, method of fastening the sides, and how the lengths of inner tube are prepared

or hood. Though the hood is designated as being 2 ft. 2 in. long, it can be made longer if more room is desired

Cut and hem the ends of the 10-oz. piece so that it is 6 ft. 10 in. long. When sewed on top of the heavy canvas with one end even with the 6 ft 4 in. mark and the other end overlapping the 12 ft. 8 in. mark, this piece forms the pockets which hold the tubes. These pockets are made by rows of lengthwise stitching about 6¼ in. apart. Marking these rows will make stitching easy. Six inches from the head flap end of the 10-oz. piece and in the center of each pocket, mark the holes for the grommets through which the valve stems will pass.

SNAP hooks (or patent fasteners) are sewed along the sides in such a way that the upper flap covers the lower one, making the joint rain-proof. These fasteners are placed on each side of the bed in the manner shown in Fig 4

Lightweight automobile inner tubes are to be preferred because they will make the bed more compact and lighter. The 29 by 4.40 tubes are about the right size and are easily obtained. They are cut about 3 in from the valve stem; and the opposite end is cut again so that the tube measures 6 ft. 4 in from end to end

Now, roughen the inside of each tube back about 1 in. from the ends. Apply a thin coat of rubber cement and allow to dry overnight. Put on two more coats allowing each to dry in the same way Thoroughness at this point means the success of the project. After the third coat has dried, press the sides together to make a flat seam at right angles to the valve stem (see Fig. 4). Work the joint thoroughly, paying particular attention to the ends of the seam where the wall of the tube returns upon itself. The joint should then be put into a clamp until it has had ample time to set

THE valve plungers are extracted and a disk wheel type valve cap is used to hold the air. The tubes may be easily fished through the open ends of the pockets by means of a wire, and the stem inserted in the grommets at the head end

The inner sleeping bag may be of wool quilting made to size and opening down the side with a patent fastener, or it may be of ordinary bedding folded and pinned with blanket pins (see Fig. 3). This keeps out cold and dirt, and it is not necessary to remake the bed each day If the corners of the inner bag are fastened to the corners of the outer, all that is necessary in arranging the bed, is to straighten the outer bag

After the inner bag is in place and the cover flap is fastened in place, the tubes may be inflated. Do not inflate them too fully, three or four lungfuls generally being enough to keep the body free of the ground.

When preparing to roll up the bed, just remove the valve caps. As the bed is rolled from the foot, the air will be forced out through the valve stems at the head

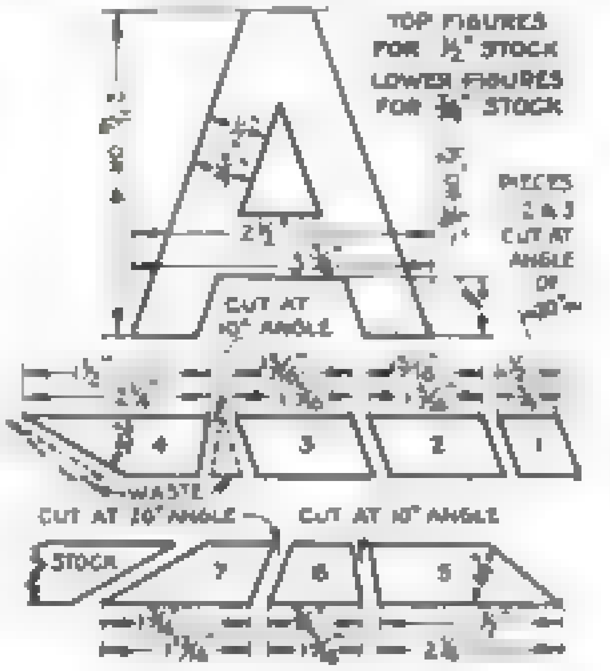
The writer has used a bed like this on many trips during the past year and a half and has found in it a splendid piece of equipment for the enjoyment of the out-of-doors

Brain-Teasing Block Puzzles

By ERIC B. ROBERTS

HERE are two more block-puzzle teasers. They can be made in two sizes, the parts being either ½ or ¾ in. wide and of any desired thickness.

In cutting the letter-A puzzle from wood, you will need a miter box marked in degrees, because the cuts must be

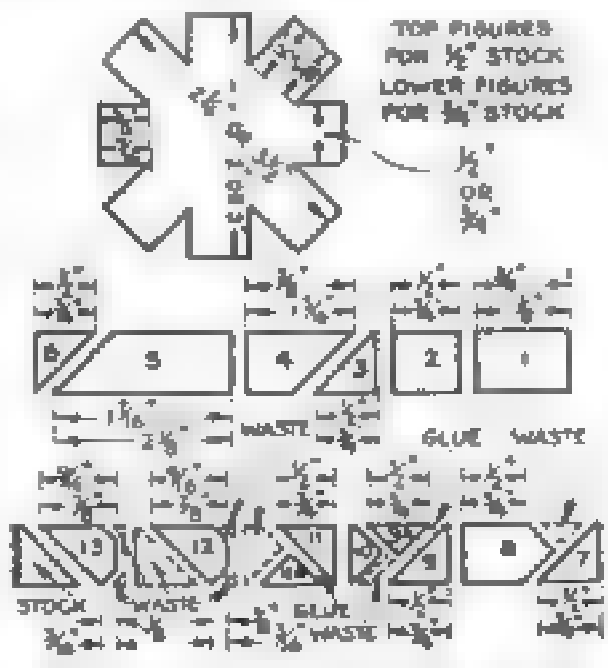


These block puzzles can be made from either ½ or ¾ in. wide wood or cardboard stock

accurate. If you do not own an adjustable miter box, it is better to make the puzzle from stiff cardboard, using a protractor to lay out the correct angles.

The double cross puzzle is composed of fifteen pieces, two of which must be glued as shown, making thirteen pieces when ready for assembling. All cuts are at right angles or at 45°. Be sure always to allow for the thickness of the saw. For example, the point of piece *10* must be trued up after *9A* has been cut off. The pieces are shown right side up, and are cut off in the order given.

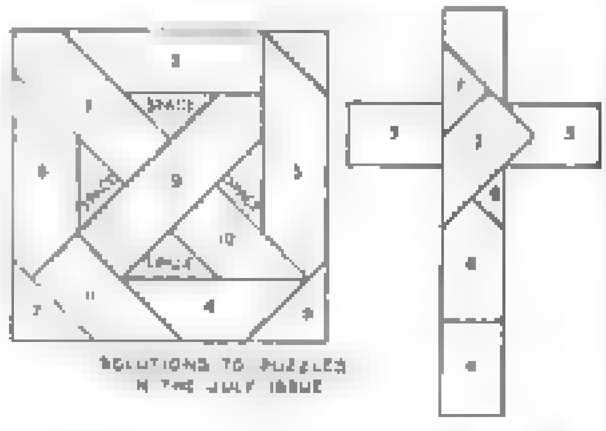
Number each piece on the top to aid you in the solution, and color or otherwise mark each set to avoid mixing. It is also a help to draw the outlines of the puzzles to the dimensions indicated, but



Double cross block puzzle. Piece No. 9A is glued to No. 9 and No. 11A is glued to No.

choose the set of figures which corresponds to the width of the stock used.

Solutions to these puzzles will be pub-



The solutions to the block puzzles which appeared on page 117 of the July 1930 issue

lished in the September issue. The two diagrams above show the answers to the puzzles described last month (P.S.M., July '30, p.117).

ANSWERS TO QUESTIONS ON WORKSHOP FACTS

BELOW are given the correct answers to the home workshop questions given on page 75. The wrong word or terms have been left out in each sentence.

1. The teeth on a *crosscut* saw are beveled.
2. *Direct* current should be used in plating and similar electrochemical reactions.
3. Shellac is thinned with *alcohol*.
4. A good average speed for wood turning in a lathe is a cutting speed of about *1,000 to 1,500* feet per minute.
5. Oak, walnut, ash, mahogany, gum, and chestnut are all *open* grained woods.
6. Brushes used for house paint should be cleaned with *gasoline*.
7. The *fore* plane is larger than the jack plane.
8. The *hair* side of a leather belt should run on the pulley.
9. More oil is contained in *gloss* paint than in *flat* paint.

CLEANING RAZOR STROPS

WHEN the grain of your razor strop has become "filled" with oil, dirt, and the wear of steel blades, and will no longer give the service for which it was intended, it can be renovated at no cost whatever and within two minutes' time. Turn the fine edge of an old blade by drawing it, under pressure and at about a 45° angle, across a bottle-neck. Place the strop on a table or other perfectly flat surface and scrape it clean with the turned edge of the blade, taking due care not to cut the leather by moving the edge sidewise.—CHARLES H. LIEB.

$100 in Prizes for Bottle Models

(Refer to page 71)

TO ENCOURAGE a friendly competition among model makers, POPULAR SCIENCE MONTHLY will give $100 in cash prizes for the six best ship models built in bottles according to the general method described by Captain McCann. The awards will be as follows:

First prize, $50
Second prize, $25
Third prize, $10
Three prizes, $5 each

Each model must be built especially for this contest. The construction should follow the general principles given in the article on pages 71–73, and all parts must be inserted through the neck of the bottle. The model does not, however, have to be a clipper ship; it can be any type of ship model, with or without sails. The bottle may be of any shape or size.

To enter the contest it is necessary to submit the following: 1. A photograph (or photographs) of the model before it is folded and inserted in the bottle. 2. A photograph of the model in the bottle. 3. A brief written description of the model including the general dimensions, the size of the bottle, and the diameter of the neck opening.

From the photographs and descriptions, the judges will make a preliminary selection of a number of the most promising models and ask that these models be shipped to New York. The final selection will be made from the models themselves. Do not, however, ship your model until requested to do so. Models will remain the property of the builders and will be returned.

The main points in judging will be (1) the craftsmanship shown, (2) the general decorative effect of the model, (3) the accuracy of the model in design and scale, and (4) the completeness and amount of detail in relation to the comparative size of the model and the diameter of the bottle neck.

All entries must reach the Ship Model Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, on or before October 15, 1930.

Anyone is eligible to compete except members of the magazine staff. It is not required that a contestant purchase a copy of this magazine (it can be consulted in a library, for example), neither is it necessary to obtain blueprints. In case of a tie, prizes of full value will be given to each tying contestant. The judges will be Captain McCann and the technical and home workshop editors of POPULAR SCIENCE MONTHLY.

DRYING TACKY PAINT

AS TO what to do when the paint is still tacky at the time of repainting—in some cases a mixture of three fourths turpentine and one fourth drier will dry up the sticky paint. In other cases, a coat of aluminum paint will serve.

Auto-Camping Trailer Built for Less Than $25

By HALVOR ANDERSON

The empty trailer weighs 300 lb. and is attached by means of a universal coupling, which is bolted to the spare wheel carrier

DOES it pay to build your own trailer? That is the question I asked myself—and the answer is the trailer illustrated, which cost $23.30.

My object was to build it both substantially and economically. The angle iron for the framework and the curved brace on the front were obtained from an old iron cot. An old Ford front axle was bought for 50 cents and two Ford springs for $1 each. Shackles and other parts cost $2.60, machine parts $2, tubing 50 cents, bolts 50 cents, lumber $2.70, wheels $3, and welding $9.50.

As shown in the drawings, 3/4 by 3 by 3 in. steel plates were welded on the axle to serve as spring pads on which to fasten the springs. The Ford front spring hangers were welded in position on the angle iron frame after their shanks had been sawed off. The front shackle was welded solid and a brace added on the outer edge of the spring. The rear shackle floats.

The flooring and sides were fastened by means of 5/16-in. bolts with lock washers. A piece 2 by 4 by 17 in. was attached to the bottom as shown to allow the 1-in. steel tubing to be secured firmly. This tubing was an old tie-rod from a junked car. Ordinary pipe would not do because the seam would open up when forging this part to shape.

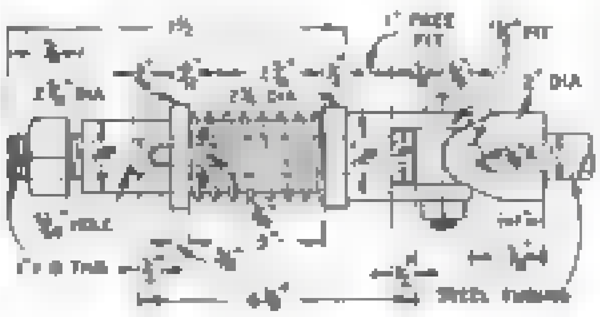
As I had the use of a lathe and drill press in a garage, I made the universal puller, thus saving the cost of a commercial puller. The advantage of this type of puller is that the spring tension reduces the road shocks when the trailer rides over bumps.

After the trailer was assembled, a 1-in. hole was drilled in the spare wheel carrier at the back of the automobile to allow the end of the puller to pass through and be secured by means of a single nut and lock washer. As an additional precaution, however, a 3/16-in. cable was added as a safety puller. It was looped around the front brace of the trailer and then bolted to one of the studs used for holding the spare wheel in place. If a

Assembled views of the trailer showing the chief points of the construction. Ford wheels, springs, shackles, and front axle were used

spring snubber is wanted, an old inner tube can be passed around the axle and bolted to the floor of the trailer.

The trailer weighs 200 lb. empty and has undergone severe and extensive tests loaded with sandbags weighing 500 lb.



Working drawing of a universal spring puller which can be made in the lathe and drill press

Materials for Trailer

No. Req.	Materials and Use	Dimensions
1	Ford front axle	
2	Ford springs	
4	Ford shackles	
4	Shackle hangers	
2	Ford wheels	
8	Lag bolts for springs	[illegible] by 2½
5	Lag carriage bolts in floor	[illegible] by 4
10	Carriage bolts for brackets	[illegible] by 1½
7	doz. Lag carriage bolts for boards	[illegible] by 1[illegible]
2	Angle irons 60½ in. long for sides	¼ by 1½ by 1½
2	Angle irons 38½ in. long for ends	¼ by 1½ by 1½
4	Angle irons 10½ in. long for corners	[illegible] by 1½ by 1½
2	Angle irons 6 in. long for spring	[illegible] by 1½ by 1½
2	Steel for front end spring braces	[illegible] by 2 by 7
2	Boards for sides	1 by 12 by 62
2	Boards for ends	1 by 14 by 38½
11	Matched boards for floor	1 by 6 by 38½
1	Matched board for floor	1 by 4 by 38½
1	Board for puller base	2 by 4 by 17
2	Steel for front corner brackets	[illegible] by 1 by 7
2	Steel welded on axle for springs	[illegible] by 3 by 3
4	Steel for securing springs	¼ by 1 by 3
1	Steel tubing for puller	1 by 30
1	Universal puller	

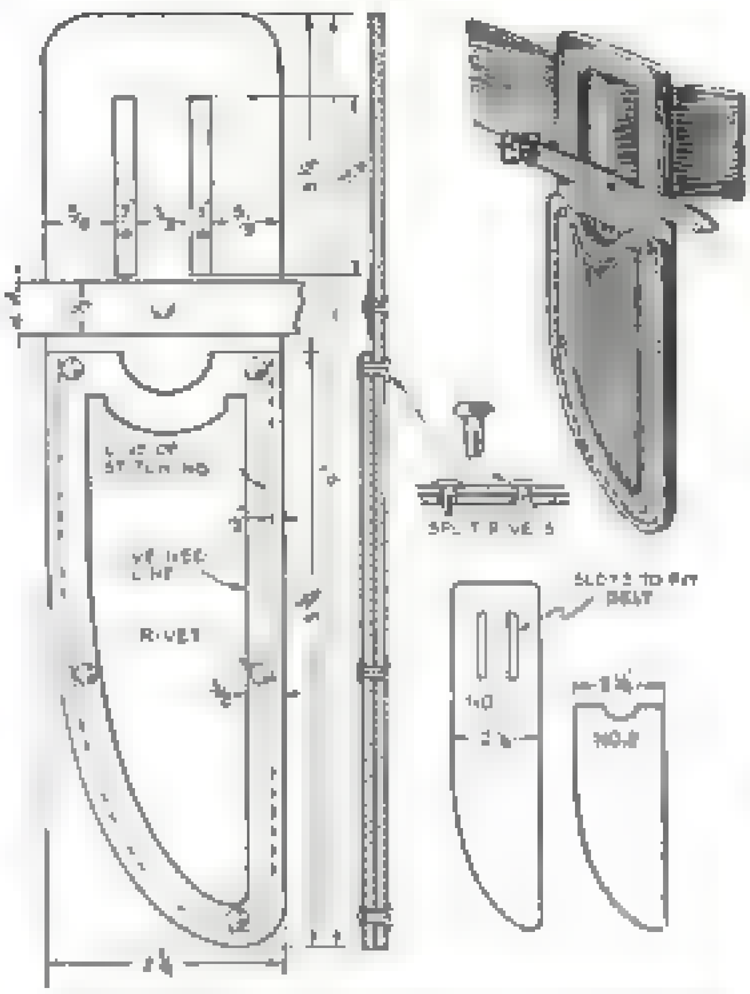
NOTE: All dimensions are in inches.

REMOVING OLD FINISH

IN REMOVING varnish or other finishes after they have been softened with a commercial remover, a liberal supply of sawdust may be used to soak up the old finish instead of rags or excelsior. After most of the finish has been removed, the surface is brushed briskly with an old whisk broom or coarse brush to clear away the dried particles from the work. I find that this method works quickly and insures more thorough results.—GEORGE CURREN.

Providing Your Hunting Knife with a Durable Sheath

By F. CLARKE HUGHES



The dimensions need serve only to give the proportions of the sheath, as the size can be varied to fit any knife

EVERY hunting knife deserves a good sheath, whether it is a homemade knife, such as was described in a previous issue (P. S. M., July '30, p. 116), or a commercial knife the sheath of which has been lost or worn out. It is not difficult to make a durable and neat looking sheath from three small pieces of good grade sole leather and a few split rivets.

Cut patterns from cardboard or tough paper to fit the knife, making allowance for the seam and rivets, and transfer the outline to a good grade of sole leather about 1/8 in. thick, which may be purchased at any shoe repair shop.

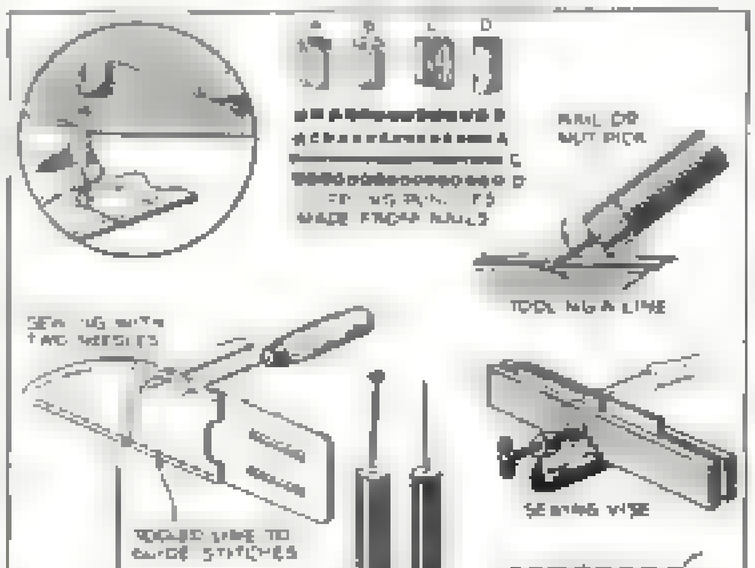
There are two ways in which the stock may be cut. One plan is to have the face of both pieces toward the front, leaving the back of the sheath unfinished. The other method is to turn the face of No. 1 toward the back and the face of No. 2 toward the front, in which case the upper portion of piece No. 1 should be faced or lined in front with thin leather to give a finished appearance. Usually the first method is followed.

The slot in piece No. 1 is cut to fit a man's belt. The small strap may be a wrist strap from a discarded wrist watch or any small strap with either a buckle or a snap fastener on the end. The strap is fastened with one rivet as shown.

The design, which is applied to part No. 2, may be a border line tooled with a leather tool, a blunt awl, a nut pick, or other suitable tool. A more ornate border can be obtained through the use of a stippling punch made by filing the desired design in the end of a large nail. Several such designs are shown. Another method is to tool the border lines and to stipple the inclosed space. This stippled surface may be toned, if desired, with a colored wash made by mixing oil paint with gasoline to form a thin stain. The stain should be partly wiped off before it dries.

The leather should be kept wet during the tooling operation, but should be allowed to dry thoroughly before the stain is applied.

The line of sewing is laid off on the face of piece No. 2 about 1/8 in. from the edge. All stitches should be 1/8 or 1/4 in. apart. The sewing is done with the aid of two needles as shown below at the left.



The stippling punches and a leather tool, and how the sewing is done with a homemade awl and a sewing clamp

If a narrow but deep vein is tooled along the line of the stitches, it will serve to keep them even and smooth. Dampen the parts and place them together in a vise or clamp before attempting to do the sewing, and make the holes for the stitches with a very fine awl as you proceed. Use very heavy, strong linen or flax thread waxed with beeswax.

After the sheath is sewed, the rivets are inserted to keep the edge of the knife from cutting the stitches. Be careful not to cut the threads when inserting the rivets.

Smooth and round the corners of the sheath with fine sandpaper and polish the whole with shoe polish or floor wax.

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, Popular Science Monthly offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

Popular Science Monthly,
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I enclose

dollars *cents*

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- 30. 36 in. Rise off Ground Tractor
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- 82. 30 in. Single Stick
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- 89-90. *Bremen* 3 ft. flying 50c
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- 104. Tractor (record flight 6,024 ft.)

Furniture

- 1. Sewing Table
- 2. Smoking Cabinet
- 3. End Table with Book Trough
- 5. Kitchen Cabinet
- 13. Tea Wagon
- 17. Cedar Chest
- 18. Telephone Table and Stool
- 19. Grandfather Clock
- 20. Flat Top Desk
- 21. Colonial Desk
- 24. Gateleg Table
- 31. Two Sewing Cabinets
- 33. Dining Alcove
- 36. Rush Bottom Chair
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- 52. Welsh Dresser
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- 78. Treasure Chests
- 88. Modernistic Stand and Bookcase
- 91. Folding Screens
- 93. Three Modern Lamps
- 100. Modernistic Book Ends, Book Shelf, Low Stand
- 108. Tavern Table and Colonial Mirror

Radio Sets

- 103. One Tube (battery operated)
- 42. Three-Stage Amplifier
- 43. Four Tube (battery operated)
- 54. Five Tube (battery operated)
- 55. Five Tube Details
- 79. Electric
- 80. Electric High Power Unit
- 81. Electric Low Power Unit
- 97. One Tube Electric
- 98. Two Tube Electric
- 99. Four Tube Electric
- 109. Screen-Grid Set

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- 74-75-76. *Santa Maria* 18 in. hull 75c
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- 92. Baltimore Clipper (9 in. long)
- 94-95-96. Mississippi Steamboat, 75c
- 106-107. 42 in. Racing Yacht, *Sea Scout* 50c
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- 108. Scenic Hall Model of Barque
- 110-111-112. Schooner *Bluenose*, 75c
- 115-116-117. Concord Stagecoach, 75c
- 118-119-120. Covered Wagon, 75c
- 121-122. Clipper Ship in a Bottle, 50c

Toys

- 26. Pullman Play Table
- 56. Birds and Animals
- 67. Lindbergh's Plane
- 72. Colonial Doll's House
- 73. Doll's House Furniture
- 101. Fire Engine, Sprinkler, Truck, Tractor
- 113. Lathe, Drill Press, Saw and Jointer
- 114. Airplane Cockpit with Controls

Miscellaneous

- 15. Workbench
- 26. Baby's Crib and Play Pen
- 30. Tool Cabinet, Boring Gage and Bench Hook
- 65. Six Simple Block Puzzles

Price 25 cents each except where otherwise noted

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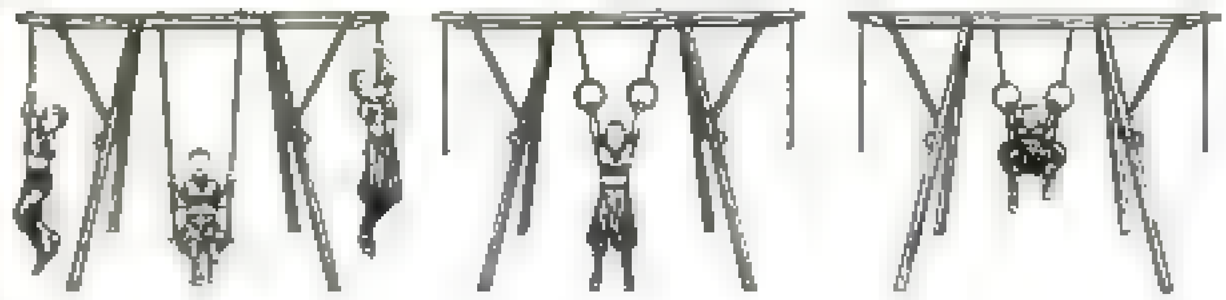
City and State

Motor is Cushioned in Rubber

Mounting motors on blocks of live rubber is now common practice in the automobile industry. Engineers of the Outboard Motors Corporation have gone a step farther in perfecting their Fold-Light model "World's Lightest Twin." The entire motor head is cushioned in rubber bearings. This minimizes vibration and wear and contributes to long service life.



Making a Gym for Boys

Swing, horizontal and parallel bars, rings, and trapeze in one combination

By CHARLES A. KING

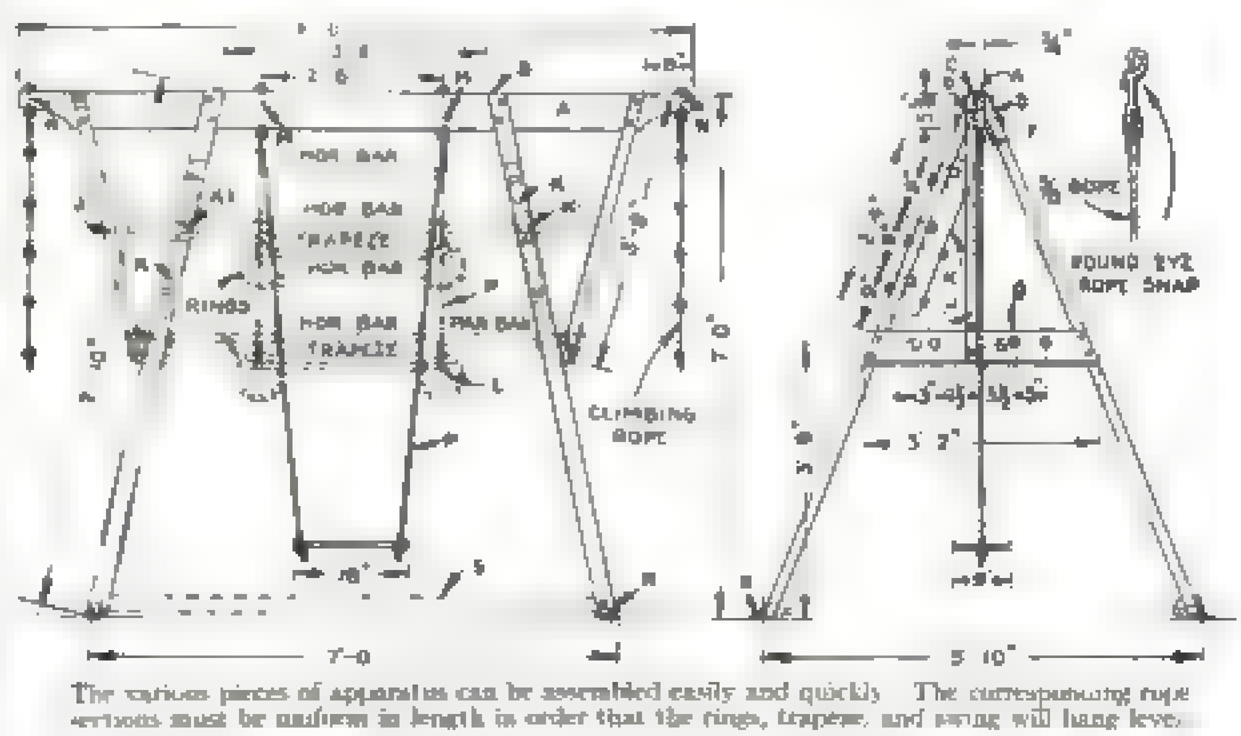
WITH its five varieties of apparatus, this easily constructed combination forms a complete gym for children up to twelve years of age. The horizontal bar, trapeze, and rings can be adjusted to suit the skill and experience of each young athlete. The climbing ropes at each end really form a sixth feature: they have been added to maintain the interest of those who are waiting their turn at the main apparatus, so that three children can use the equipment at one time.

The frame may be made of well seasoned ash or spruce. The header *A* should be 1¾ by 5¼ in. by 9 ft. and should be shaped on the ends as shown. Make the four legs 1¾ by 2¼ in. by 7 ft. 10 in., cut the top end at the angle shown at *B*, the end bevel as at *C*, and the side bevel as at *D*. These cuts should bring the legs in pairs, one pair slanting to the right and the other to the left. To accomplish this, draw a full size detail on the floor, lay the legs in place, mark the side bevel *D* accurately, and make the lower end *E*, as shown on the following page, parallel to the angle *B*. Saw close to the lines, and the pieces thus cut will fit against the header as at *F* to give flat bearings for the legs.

The cross braces *G* are 1¼ by 4¼ in. by 3 ft. 2 in. (verify the length before cutting); these are placed as shown. Locate the bolt holes of each leg and cut recesses as at *H* in the detail on the following page to provide a square bearing for the bolts. Drill holes in *G* to receive the parallel bars as indicated at *Q*. Before any piece is fastened in place, see that each exposed corner is well rounded to avoid the danger of splinters.

Place brace *G* on the legs and fasten with 5/16 by 5 in. bolts. Nail a stay lath temporarily across the bottom.

Assemble the legs and header by holding each pair accurately in place with laths and sixpenny finishing nails. Be

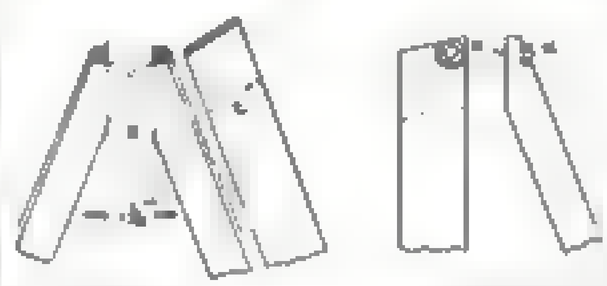


The various pieces of apparatus can be assembled easily and quickly. The corresponding rope sections must be uniform in length in order that the rings, trapeze, and swing will hang level.

careful that no nails are driven where they will interfere with the boring of the ⅜-in. holes for the bolts which are placed at right angles to the joints between the legs and the header. Fit pieces F, glue them in place, bore the ⅜-in. holes, and set all bolts up with washers to protect the wood.

The two braces J, 1¾ by 1¾ in. by 3 ft. 9 in., may be made next. Each is fastened with a ⅜ by 7½ in. bolt (verily) and a ⅜ by 3 in. lag screw at the bottom. When fastening these pieces, adjust the stay laths until the frame is standing square and the corresponding angles of each are equal. Fasten the top of J with ⅜ by 4 in. bolts.

The horizontal bars may be either pipe or wood, 1¼ or 1½ in. in diameter and 6 ft. long. These also serve for the parallel bars. Supply the bars with pins, or removable caps if pipe is used, so that they will not slip out of the holes in the supporting cleats K and Q. The trapeze



DETAIL OF TOP OF LEGS   METHOD OF FITTING BOLT HEADS

How the legs are shaped and how the boltheads are set in recesses to obtain a square bearing

may be of the same diameter and 3 ft. long, with a ringbolt placed at each end as suggested at L.

Make the two horizontal bar cleats K, 1¾ by 3½ in. by 2 ft. 4 in. Be sure that the holes to receive the horizontal and parallel bars admit them freely but not too loosely, and that they are horizontal to insure a firm bearing for the bar as shown by the dotted lines at K'. Fasten the cleats with ⅜ by 5 in. bolts.

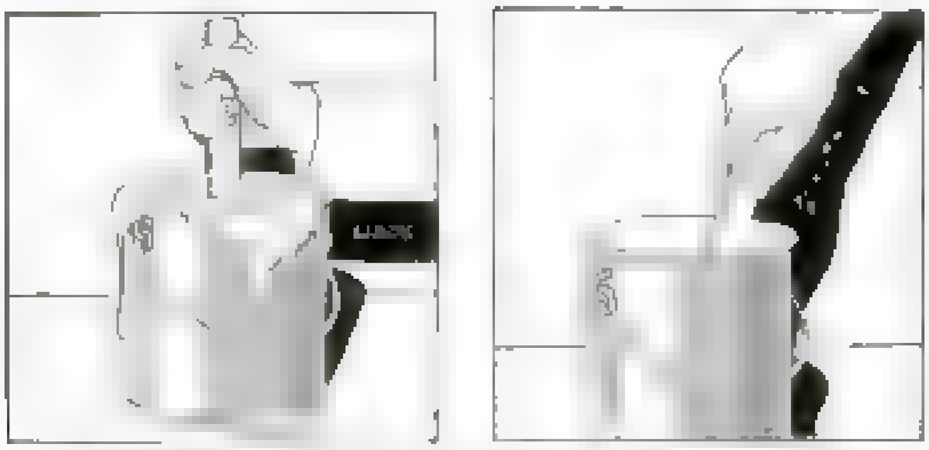
Place ⅜ in. ringbolts at M and at N. Obtain 25 ft. of ⅜-in. manila rope and ten ⅜-in. round-eye rope snaps. Make an eye splice at one snap, allow for another splice, cut off and splice to another snap, and continue for four lengths of rope P, and two extra lengths for the swing. The swing, the rings, and the trapeze must each hang level, therefore it is necessary that some care should be used in securing uniform finished lengths of about 18 in. for the four ropes and 30 in. for the two additional swing ropes.

If the frame is to be secured to the floor by angle irons as at R, you are ready to fit the legs to the floor and fasten them, but if it is desirable to move the little gym around, stretchers S may be necessary, although such pieces are always a potential danger in any athletic equipment and should be avoided if possible.

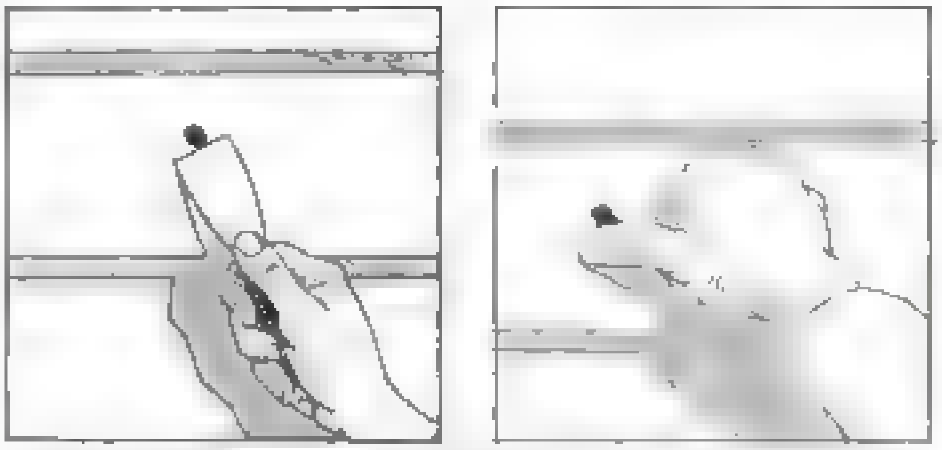
Purchase two 6-in. rings to which a snap can be fastened. Cut off all threaded ends of bolts that project beyond the nuts and file them smooth so there will be little danger that anyone will be cut on them. Sandpaper all rough places and smooth carefully wherever splinters may exist. Remove all finger marks and soiled places and apply two or three coats of good, hard-drying varnish.

When You Do Outside Painting

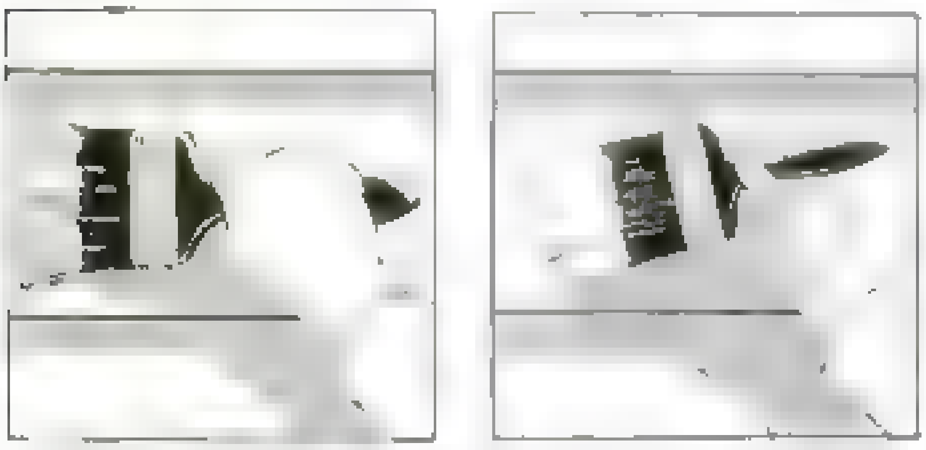
These Six Practical Hints by BERTON ELLIOT Will Insure a Durable, Good-Looking Finish



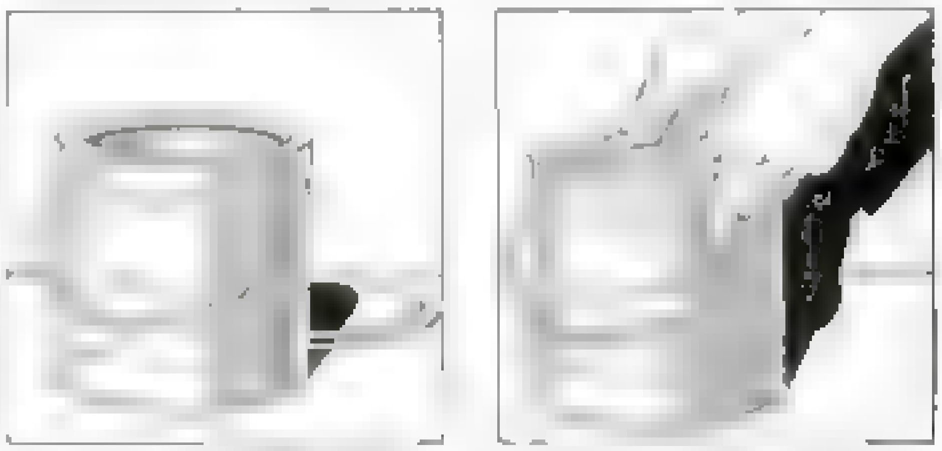
UNLESS paint is properly mixed before it is used, it cannot be expected to give good results. Stirring round and round in the manner shown at the left will not mix paint thoroughly, and attempting to stir a full can will generally result in the spilling over of a good deal of the oil. Before stirring paint, dip or pour some of the oil from the top. Stir the remainder by starting at the bottom and bringing the paddle to the top with a twist as at the right. Pour the oil back, little by little, and stir gently. Finally pour the paint back and forth from one can to another



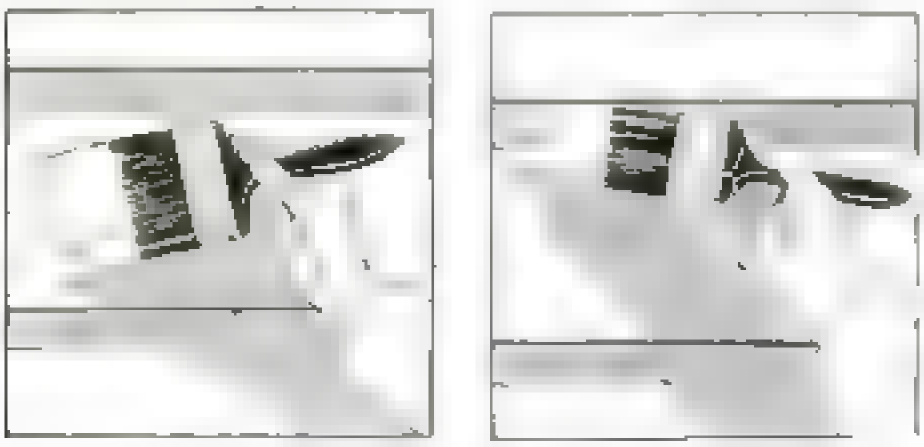
IN FILLING holes or cracks with putty, do not use a stiff putty knife as shown at the left, for it will push or pull the putty away from the hole. Good practice is shown at the right. Roll out a little of the putty between thumb and forefinger, press it down firmly into the hole, and remove the excess with a downward twist of the thumb. For long cracks which cannot be readily filled in this manner, a flexible putty knife, used in much the same manner as the fingers, will serve. For large openings, stuff paper, rags, or oakum into the hole before applying the putty



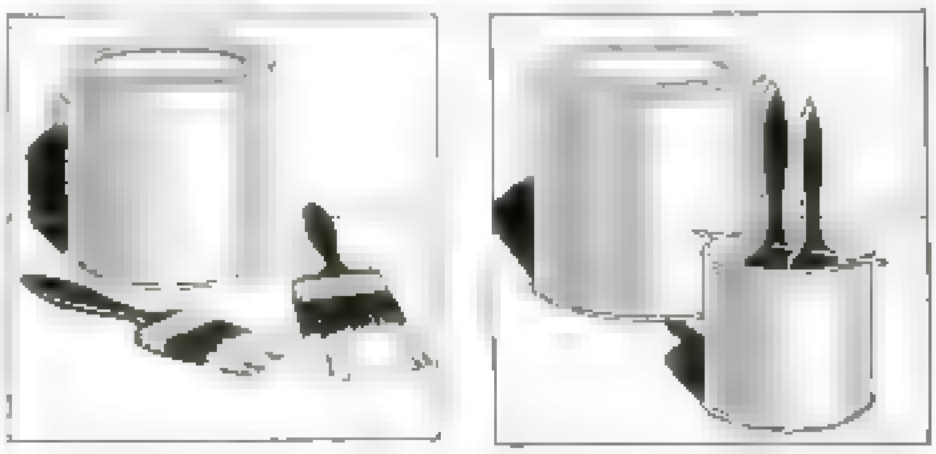
THERE are many ways to hold a paintbrush, but, generally speaking, only one right way. Never grasp the brush as at the left, but rather hold it as shown at the right. The brush should be held between the thumb and fingers and applied with an even movement of the wrist. Use long, continuous strokes and exert an even pressure at all times. This position must be altered according to whether the point of application is high or low, but the general principle is the same in all cases. Hold the brush lightly at all times, yet brush the paint vigorously into the surface



DO NOT leave paint uncovered when not in use. Dirt and possibly water will get into it and may spoil it for good work. Paint left uncovered will also "skin over." If the cover cannot be replaced, tie a piece of newspaper or cloth over the top of the bucket. In cases where the paint has been left uncovered, the skin should be removed in one piece by cutting around the edge with a putty or mixing knife and by lifting it off. If the skin is broken up, it will not dissolve and will make the paint lumpy. Pieces of skin can be removed from the paint by straining it.



IN PAINTING clapboards, do not start painting the flat part first, as shown at the left. The proper way is to paint the underneath edges first, as shown at the right. Brush along several edges at a time for a space of a few yards. Then coat the faces of the boards. If the edges of the boards are not painted, they will be without a protective coating, and the moisture from rain and snow will get into the wood and cause the formation of blisters under the paint. If the flat portions are painted first, some of the paint will be wiped off when the underedges are coated.



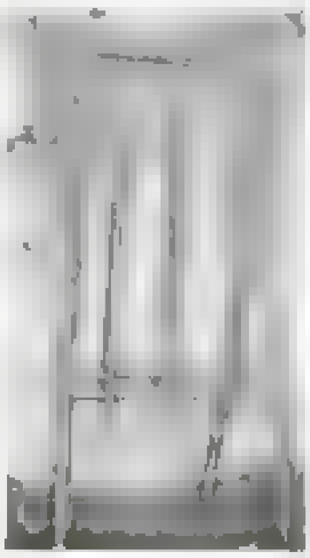
IF LEFT lying around when not in use, brushes will become hard and unfit for use. They should be cared for after each job. One of the simplest methods, if you intend to use the brush again within the next day, is to suspend it from a wire in some of the paint you are using or in linseed oil, as shown at the right. Another good method is to fold a sheet of paper, freshly painted with some of the paint, over the bristles to form a water-tight jacket, and stand the brush in water. When a job is done, clean the brush in a suitable solvent and wash it with soap and water

FOLDING DRYING RACK FOR USE INDOORS

A CONVENIENT folding rack for drying a few small articles indoors can be made as illustrated in the accompanying photographs from stock wooden dowels, a piece of webbing, six large screw eyes, and two rivets.

The rack as set up in a bathtub to make possible the drying of a few light articles overnight

The stand opens up scissors-fashion and is intended to stand in the bathtub. Each pair of legs is pivoted about three quarters of the way up with a copper or steel rivet. A heavy bit of webbing is fastened across one pair of legs to keep them from opening too far.



When folded, the rack will go into a closet

Crosspieces join the corresponding legs on each side, one piece being placed near the top of each set, and the other near the bottom. Each top crosspiece is slipped through screw eyes driven into the ends of three of the drying arms.

In use, the three arms pivoted on one crosspiece are thrown over so they rest on the opposite crosspiece, as shown in the upper illustration.—Charles B. Barr

SOLDERING LEAKY PANS

BEFORE attempting to repair a small leak in a pan or kettle, rub the spot around the hole inside the dish with emery cloth or other abrasive until bright. Place the hot copper under the hole to heat the metal. Rub the upper side with flux, then apply a drop of solder. If one of the solders containing flux is used, merely apply the solder. The solder should not extend below the hole.

For larger leaks or spots, clean the lower side and cut a small tin patch to cover the hole with a liberal lap. "Tin" the lower side evenly with a thin coat of solder; then apply the tin patch and heat it with the copper until it has been firmly attached or "sweated" in place. Next cover the edges with solder and later file the solder smooth.

Kitchen utensils made from aluminum can be soldered successfully only with special aluminum solders, but usually the leaks can be repaired without solder by using household mending patches, which are applied by means of small screws.

Splicing a Cable in Mid-Atlantic

(Continued from page 57)

men took their places at the sheaves, I went on a tour of inspection of the ship with the chief electrician as my guide. Below the main deck, I found a bewildering array of winches for winding in the grapnel rope; and below that several almost unfathomable steel tanks, about thirty-four feet in diameter, in which hundreds of miles of cable and rope could be coiled. In the engine room, one fireman was doing the work of six—and doing it more easily—for the *John W. Mackay* is an oil-burner. The dining saloon was exactly like that of an Atlantic liner, only built on a smaller scale. The service and the meals, by the way, were equally as good, and perhaps a little more "filling."

The smoking room, where checkers, chess, and bridge were played when the officers were off watch, had its piano, library, and phonograph. There was one galley for both officers and crew; an economical arrangement that also tends to forestall "kicks" about the food from the fo'c'sle. Above, on the main deck amidships, were the officers' quarters, electrician's cable-testing room, wireless room, purser's office, and so forth. The crew numbered ninety-one—including myself. This is one of the items that go to make the maintenance cost of the vessel about $4,500 a week, for a cable-repair ship pays top wages and overtime. The cable with which she repairs breaks and faults costs from $1,500 to $3,000 a mile. Which makes cable-laying a rather expensive proposition.

WE WERE nearing the cable line; at any moment now, something might happen. So the bow was the place for me. There I found Captain Livingston sitting on the taut line, just abaft the sheaves—a cold, wet job but the only way to detect the gradual tension and vibration that always accompanies the hooking of a cable. The dynamometer, registering in hundreds of pounds, can be relied upon only in very deep water. The indicator was swinging back and forth between 1,200 and 1,600.

For another half mile the ship drove slowly through the late afternoon haze, the skipper at his post on the jute-covered steel cable-rope. Suddenly, he became tense and grasped the rope with one hand.

"Got something!" he announced, briefly. Was it the cable broken by the earthquake, or one of the lines abandoned years ago? Or had the grapnel buried its nose in the brown clay that now seemed to overlie the time-honored black mud? All eyes were on the dynamometer. The indicator, which but a moment before had registered a strain of 1,600 pounds, was climbing to 1,800—2,000—2,400! This could mean but one thing—the cable.

THE quartermaster on the port deck, less than thirty feet from the skipper, grasped the levers of his engine-room telegraph, waiting for orders. They were not long in coming.

"Stop her!"

Two hundred feet astern, in the bowels of the ship, the assistant engineer got the signal, and shut off both the port and starboard engines. From then on, they were used merely to steer the vessel.

"Ahead on the winch!"

The cogs started grinding. The ship had lost headway, and began to reel drunkenly. As the cable-rope came over the sheaves, the skipper watched it with an anxious frown. There's many a slip 'twixt the clay and the ship! No cable is ever considered "hooked" until it is on deck. The pressure down there in the stygian blackness is 4,350 pounds to the square inch.

As the cable-rope was wound upon the seven-foot drums, the ship was forced slowly backward, until eventually she was almost directly above the flat-fish hook, instead of a mile in advance.

At the end of two hours of steady grinding, the deck watch, in rubber boots and oilskins, lined themselves up along the rail. Two of them tied a few short lengths of rope to their suspenders. Slowly and carefully the cable was brought from the depths, until the chain attached to the grapnel came clanking over the sheaves. Darkness had fallen, for it had taken three hours to reel in the three miles of grapnel rope. A deck-hand brought forward a cluster of electric lights, equipped with a reflector. Leaning over the rail, he played his "spotlight" on the water at the bow. The tenacious flat-fish hook was just breaking water, with the cable in its grip.

"Stop her!"

THE winches ceased their din, the heavy cable-rope, weighted down with the chain, quivered under the strain.

This was the cue for the lads with the short lengths of rope attached to their suspenders. They leaped atop the sheaves, stepped into boatswain's chairs, and were lowered over the bow to make fast the cable to two lines, the grapnel might cut it. I, too, was lowered over the rail in a similar rig. A few feet below the grapnel, the two seamen quickly lashed the two cable lines to ropes that ran over the sheaves. They had tried to outdo each other in speed from the first rolling hitch to the last turn, for the cable company was losing thousands of dollars a day in tolls.

A hand, suddenly flung up, was the signal for the starboard crew to haul up its man, the other followed a second later. This particular job was quickly done, for the sea was smooth, but on more than one occasion, waves have broken over them as they worked. And the temperature of the water along the Grand Banks in winter is not more than a degree or two warmer than the freezing point.

The cable was taken on board. It was covered with barnacles and marine growths, but the outside covering was intact. Brown clay still adhered to the crevices in the sheathing, indicating that the cable was buried by the earthquake. Now it was cut with a hack saw, and the severed ends brought nearer to the testing room. A length of insulated copper wire, attached to the galvanometer in the chief electrician's laboratory, was run out on deck and made fast to the core of the cable.

THE galvanometer, that indispensable instrument of the cable-repair ship, looks very much like a polished brass cylinder. It is about the size of a "dry ice" ice cream container, quart size, stood on end on a wide bench. Inside, attached to a suspended coil, is a mirror; this reflects, through a window in the cylinder, upon a graduated scale two feet away, the glow from a stationary light set directly beneath the transverse scale. In other words, as the coil within the cylinder oscillates, the distance it swings is measured on the scale.

In the laboratory, I found Carey, the chief electrician, busily tapping keys and changing plugs. Once in a while, he called out a cryptic number, which his assistant wrote on a pad; they were to be used later in certain intricate calculations. Captain Livingston walked in, anxiety written all over his grizzled countenance. He has a reputation for "getting" his cable to sustain.

It was the New York end of the cable that Carey was testing. The total electrical resistance of the cable in ohms is proportional to the mileage. Since the tests registered 1,798 ohms and, in this instance, the cable had two ohms of resistance per mile, the ship must be 899 miles from New York.

With a delicate elec (Continued on page 109)

Splicing a Cable in Mid Atlantic

(Continued from page 108)

trical recorder, the electrician communicated with shore, and found the cable was in good condition. A sigh of relief came from the skipper at this bit of information. The galvanometer wire then was transferred to the severed end of the cable, and the tests that followed showed that the cable had been picked up twenty-eight ohms, or fourteen miles, short of the break. The *John W. Mackay* thereupon proceeded to the vicinity of the actual break.

While the ship was cleaving her way through the darkness, Carey briefly explained the working of the electrical hookup of which the galvanometer is the heart. Without this, the search for a broken or faulty cable would be like the proverbial hunt for the needle in the haystack.

"WHEN a cable is laid," he told me, "the resistance of each section is ascertained by tests, and the figures are filed away for future reference. When a cable is broken or develops a fault it is joined at the shore station to a set of electrical instruments similar to what students of electricity call a Wheatstone bridge, an electrical balancing device which measures the unknown resistance of the cable section to the point of the break by comparing it with the known resistances of several lengths or coils of wire. The galvanometer shows by means of its beam of light upon the scale when the resistances have been balanced exactly. This is accomplished when the beam reaches zero on the scale. Reference is now made to the resistance tables which, for any given value of resistance, will divulge the distance, in nautical miles, to the break or fault."

On the second "drive," early the following morning, the *John W. Mackay* hooked the Newfoundland end of the cable—the first of eight vessels in the area to "put through" repairs. But it isn't always as simple as that, on this voyage, which lasted twenty-four days Captain Livingston enjoyed but one day of clear weather. In the log one sees frequent notations of gales, snowstorms, heavy swells, rough seas, and fog. Buffeted by mountainous seas and shrieking winds, the eight cable ships, far out on the stormy Atlantic, struggled for weeks against tremendous odds.

No one can predict when the *John W. Mackay*, or any other cable-repair ship, will receive orders to report for duty in mid Atlantic or mid Pacific. The ice fields off Newfoundland may run aground near a cable, gouge up the sandy bottom, and break up the strands, a trawler may hook a section off the coast of Ireland, the sharp coral beds of the West Indies may cut through the thick iron sheathing of another, or a Japanese earthquake may disrupt service in the Pacific.

Joining a cable ship, therefore, is a fine way to see the world and, incidentally, to participate in one of the most interesting and exciting forms of deep-sea "fishing" the ocean affords.

NINE TENTHS OF BODY IS NEW EVERY 21 DAYS

THE human body changes its water content every three weeks on the average, says Dr. Edward F. Adolph, of the University of Rochester. Since the make-up of the body is ninety-three percent water, this means that nine tenths of one's body substance is completely replaced every twenty-one days. Not all the matter of the body, however, is so transient. Nitrogen, the chief element in the chemical composition of muscle, is generally renewed within 290-day periods. Iron changes every 300 days. The most permanent chemicals in the body are of course those in the bones and teeth, phosphorus and lime.

Thrills of Flying Six-Ton Planes

(Continued from page 17)

for a surprise. In a small ship, you sit with the nose on a straight line ahead. In making a turn you keep it on the horizon, or a little below it. But in a big ship the pilot's seat may be several feet to the left of the center line of the fuselage. He sees the nose from an angle, as though he sat out on the left wing. So, in a left turn, the nose appears to be 'way above the horizon and in a right turn 'way below it.

The rule is: Keep the right shoulder on the horizon in a turn. If this shoulder, which is high in a left turn and low in a right turn, is kept about level with the skyline, a pilot is sure the nose is not getting up where the ship will lose flying speed and stall.

Before a pilot takes off in a tri-motored plane, he tunes up the engines to be sure they are all running at the same speed. The cruising speed of the Wright Whirlwinds on a Ford or Fokker is 1,650 revolutions a minute. The three engines are regulated by three throttles on the instrument board between the pilot and the co-pilot, so either can operate them. A master switch on the instrument board allows all the engines to be cut instantly in the event of a crash.

ORDINARILY when the propellers are turning they whine at a steady pitch. But when one of the wing "props" comes around directly behind the blade of the nose "prop" so it meets the blast of air from it, it sets up a steady "wow, wow, wow" and causes the wing motor to vibrate. The pilot has to adjust the engines so neither of the outer propellers turn exactly with the nose blade. This adjustment is too fine to be guided by the instruments. It must be done by ear.

Another reason the adjustment of the power plants is important is that if an engine on one side pulls harder than the motor on the other wing, the ship will not fly a straight course. It will edge over toward the side of the slower motor.

Once I had four hours of such flying at a time when I had to fly straight. I was piloting "The Voice of the Sky" over New York City in an advertising stunt. This is a tri-motored Fokker equipped with a loudspeaker. While I cruised over the tall buildings, the announcer back in the cabin would begin to sing: "I've a feeling I'm falling." Then he would say, "Oh, no I'm not, because we are flying with Whangdoodle gasoline and it never fails." We were giving Mr. Whangdoodle's gas a boost at so much per minute.

OUR contract called for us to begin at 125th Street and work downtown cruising back and forth along the main east and west streets. Ordinarily, such a flight would have been as monotonous as riding a mowing machine in a hayfield. But this time the right engine wouldn't "rev up," and the ship kept edging off to that side. I had to ride the rudder bar all the time to go straight.

When one wing engine cuts out entirely, I have found a trick that helps keep the ship on a straight course without having to give it so much opposite rudder. If the wing with the good motor is flown low, it gives that engine more to do and helps hold the ship straight, instead of letting it pull around toward the dead motor.

I was flying Van Lear Black, the Baltimore publisher, between Akron and Cleveland last summer when one of the wing engines called it a day fifteen miles from Cleveland. I dumped the ship over on the other wing and flew into Cleveland that way. Mr. Black asked me why I didn't straighten up and fly the way I had been flying. When I pointed to the engine with its propeller standing still, he sat down without a word. He was a good sport.

The longest nonstop flight I ever made in a big ship was when I rushed Black in a tri-motored Ford from Chicago to Baltimore, 800 miles in one hop. We crossed the Appalachian Mountains at 11,000 feet.

I beat that height by more than 3,000 feet during a thrilling battle with a storm over Kentucky last year. I was barnstorming through the south with the Ford I had tested at Dearborn. At Louisville, Kentucky, Snyder, my mechanic, got married. We took the bride for a honeymoon on the hop to Memphis. And it was some honeymoon.

A hundred and fifty miles south, we ran into one of the worst electrical storms I ever saw. The sky got black as ink. I climbed to 9,000 feet. Ugly, swollen thunderheads raced past us. Continual flashes of lightning streaked across the sky and seemed to miss the wings of the metal ship by inches. With full gun, I climbed, the big ship rocking in the violent cross-currents. The altimeter showed 14,000 feet before we were above the storm and in quiet air. The ceiling, or climbing limit, of a Ford is 14,500 feet.

FROM that height, as far as we could see, the inky clouds rolled and tumbled below. Flying by compass, I reached Memphis. Then I groped my way down through the storm, feeling for the airport. At 1,000 feet, the ground was still invisible.

I didn't dare go farther as I had no idea how low the cloud ceiling might extend. So I climbed back again, two miles upstairs, above the storm. With the wind at my back, I raced for Louisville. At times we touched 184 miles an hour. We just beat the storm in and I was as relieved as the bride when we sat down and got under cover before the rain and wind broke.

Another time that I flew a big ship through rain it was fun. That was last winter—down in Florida. I was piloting a Sikorsky amphibian due east over the sea to the Bahama Islands. I took off at Palm Beach in bright sunshine and headed out over the ocean for the sixty-three-mile overwater flight.

Three times on the way across, we ran through line squalls from a quarter of a mile to a mile and a half wide, with clear sunshine beyond. Sometimes we would burst through in a few seconds, like plunging through a sheet of paper. We could see the streaming rain miles away and we would charge toward it at full speed and slither through at more than a hundred miles an hour.

Amphibians, that can land either on water or solid ground, are great sport to fly—except when you have to pump down the wheels. This is done by means of a lever coming up from the floor between the two seats in the pilot's cabin. Valves at the rear of the cabin are placed at the "down" position and the lever pumped back and forth. This forces oil into the top of the struts and drives down pistons, which are connected with the wheels, below the hull body so that the machine can come down on land.

THE pistons move several feet and the pilot knows they are down when a pressure gage on the instrument panel points to about 550 pounds. When the valves are placed at "up" and the lever pumped, oil is forced into the bottom of the struts and the wheels lifted. It takes about three minutes of real labor to pump the oil. If the wheels are not completely down, the ship may strike on the bottom of the hull and be wrecked.

I once saw a pilot forget to put down his wheels entirely when these machines first appeared. The only thing that saved him was the fact that he landed on sand and the grains rolled. The hull slid along sufficiently to keep it from being wrecked. (Continued on page 111)

Thrills of Flying Six-Ton Planes

(Continued from page 110)

Landing any kind of a big ship is, of course, more difficult than bringing a smaller plane to ground. The speed is greater. The weight and size are greater. There is more wing spread to watch. The landing speed of a Ford is sixty-three miles an hour. A Fokker comes down at sixty, and a Sikorsky at fifty-five. When you set five tons down on the ground at sixty miles an hour, you have to be careful.

In landing a "big boy" for the first time, a pilot is likely to "fly it into the ground." He sits so high up in the plane that he still seems to be in the air when the wheels have touched. Consequently, he is apt to level off too late and to hit with a jolt. Also, he probably will come down with his tail high instead of sitting down in a three-point landing, with wheels and tailskid touching the field at the same moment.

ANOTHER tendency of a green pilot in a big ship is to undershoot the field. He is not used to landing at sixty miles an hour and he is likely to have to give the engines a "shot of the gun" in order to get into the airport on his glide. Nobody but a pilot holding a transport license has any business in a multi-motored ship. Even then, he should "take time on landings," being instructed by an experienced big plane pilot.

The first time I landed a big ship, I was warned not to fly her into the ground. I didn't. I made the opposite mistake. I leveled off a foot or two above the airport. Crash! We pancaked like a ton of bricks. Fortunately it was two feet and not twenty. I once saw a pilot bring in a tri-motored ship and make a perfect landing—twenty feet in the air. He landed with one loud "Plop!" and the fuselage cracked right in the middle. The only way the ship could have been saved would have been to jack up the airport twenty feet.

A flyer can't afford many bad landings in big ships. They are too heavy. They may crumple up. A loaded Ford, for instance, tips the scales at more than six tons, 12,910 pounds. A Fokker F10 weighs 13,100 pounds, and a Sikorsky only about a ton less than a Ford, 10,480 pounds.

A NIGHT landing in a big ship is not much more difficult than a night landing in any plane. All you need is plenty of room and good field lighting. One night, last fall, I was bringing a tri-motor from the west to Long Island. Head winds ate up the gas. The motors were consuming fifty gallons an hour. Over New Jersey, I was beginning to get worried. Suddenly, to the right, powerful floodlights flared on, illuminating a large airport. The operator at Hadley Field, eastern terminal of the transcontinental air mail, had heard my motors and thought I was a whole flock of mail planes coming in. I sat down, gassed the ship, and hopped off to my destination.

A few weeks ago, another unusual source of aid helped the pilot of a fifteen-passenger plane over Danville, Ill. He lost his bearings and couldn't locate the airport. Circling low above a golf course, he dropped a note in a milk bottle. It asked one of the golfers to lie on the ground with his head pointing toward the air field. When this was done, the flyer headed off in a bee line and soon made a safe landing.

The only time I was ever lost in a big ship was above territory I knew like a book. This was the way of it. I was flying from Memphis to Parks Field, in St. Louis. Out of Memphis, I met fog and low clouds and flew in, blind as a bat. I passed right over the field and didn't know it. A mile and a half beyond, I spotted a small hole in the clouds and came down. Right below me was a railroad crossing as familiar as the face of a friend. It was less than a mile from my mother's home. It gave me my bearings in a split second.

Dove Is Now Night Bird of War

(Continued from page 33)

of about four weeks, when they are able to fly.

The twilight squeaker is put through its paces from the time it is eighteen days old, when it is put out on the landing board of the loft just before dusk and allowed to observe the surrounding country to familiarize itself with local conditions. This liberty it enjoys for a few moments, after which it is forced to "trap," meaning to reënter the loft through the trap or cage with which all pigeon lofts are provided and which, because its openings are only four and one half inches wide, permits the birds to drop into the loft but prevents them from leaving it at will. For about six weeks, these "observation lessons" are continued nightly.

As soon as the birds become strong on the wing, they are turned out of the loft each evening and given exercise flights for at least half an hour in the vicinity of the loft. When it is almost dark they are called in with a "can rattle," a tin can containing grains or peas, and fed.

After two weeks of this training, they are taken a quarter of a mile from their home loft to a spot clear of trees and buildings and freed just after dark. Now, if they were merely liberated, the young birds would obey their time-honored pigeon instinct to sit down and roost in the dark, and no amount of coaxing or noise would induce them to fly. But if, when released, they are tossed into the air with considerable force, they will take wing in spite of the darkness and continue until they reach home.

Following two quarter-mile liberations, the distance is increased to half a mile. After two such flights, half-mile increases are made until the young night flyers master a five-mile stretch. From then on, the pigeoneers strive for further mileage, but each mile beyond the present five-mile limit is considered "so much velvet."

The night flyers are kept in a special loft which they are never permitted to leave in the daytime.

A dozen lofts, each a model of brightness and cleanliness, house the flock of 500 birds now at Fort Monmouth. They are painted red, white, and blue, for, Ross told me, pigeons have a sense of color which helps in guiding them home. For the same reason, the individual nests inside the lofts are painted red, white, blue, and brown.

In fact, the entire "course of training" the birds receive is calculated to intensify their inborn homing instinct and key it up to the highest pitch. This, Ross explained, is the way the day homers are trained to become Army couriers.

The schooling of the newly-hatched squeakers begins at the age of four weeks, when they are released from the loft and allowed to get their bearings. Then they are taught to trap immediately upon homing from a flight. This is done by keeping them in the loft without food for twenty-four hours, after which they are taken outside a short distance and liberated, one by one. A man inside the loft shakes the can rattle, and the hungry youngsters rush for the entrance trap.

In about a week, the pigeons get the idea that they must trap as soon as they reach home. This, of course, is of the greatest importance, for a pigeon flying home with a message and perching in a tree or on a roof would make a poor messenger. The pigeoneers encourage the formation of the trapping habit by feeding the birds the moment they enter the loft.

Now the youngsters are ready for their first real practice flights. They begin by flying a few hundred yards with the loft in sight. Gradually the distance is increased to miles; they are able to do five miles when they are eight weeks old. After that come the group flights. Fifteen or thirty pigeons are taken in baskets ten miles from the loft and liberated.

Careful note is made of the time of release, and at the loft the arrival of each bird is timed. This is done by taking the registered number on the aluminum band each pigeon carries on its leg. The distance of the daily group flights is increased until the young birds are doing 100 miles without stop.

When the birds have been trained in groups, they are flown in pairs. But an interesting point is that two mates are never released together. Pigeons are monogamous; once a bird is mated it remains with its mate throughout its life. And this mating instinct is used to reinforce the homing instinct. Before a pigeon is entered in a long race, for example, it is separated from its mate for a day or two and it will fly its heart out to reach home. When there are youngsters in the nest, it also will increase its speed several yards beyond its usual rate. A hen, however, will fly faster to her squeakers than a cock.

When the training in pairs is finished, the birds are taught to fly singly. To fly a long distance alone is more difficult for a pigeon, because in a group it has the advantage of the "drag" of the other birds. Now it has to learn to be its own guide and pilot and to pick out a roosting place if night comes before it reaches home.

The average speed of a well-bred, well-trained homing bird is fifty miles an hour. Twelve years of careful selection and expert training have worked wonders with the Army birds. Immediately after the war, a speed of 1,000 yards a minute was considered exceptional. Today flights of a mile (1,760 yards) a minute are not unusual. Not long ago, an American pigeon did 300 miles at the rate of 2,100 yards a minute, which is a little better than seventy-one miles an hour!

"Doughboy" is the mile-a-minute flyer at Fort Monmouth. In last year's national races, it flew from Chattanooga, Tenn., to the fort, a distance of 720 miles, in eighteen hours, six of which must be subtracted for roosting time. The champion long-distance flyer at the post is "Topeka Hen," which flew from Topeka, Kan., to the fort, a distance of about 1,500 miles. This championship flight the bird achieved purely by accident. Together with a number of other pigeons, it was shipped to a fancier in Topeka, whence it escaped and flew home. Next in line is "Scott Field," which covered a distance of approximately 1,000 miles, from St. Louis, Mo., to the fort.

While these birds are regarded as the pick of the flock, none is held in higher esteem than the "hero pigeons." Of these, only two survive. One, "The Mocker," lost an eye at the front. Early in the morning of September 12, 1918, this bird homed into signal headquarters miles behind the line after a flight from the front line trenches at Beaumont. The American troops had been suffering great losses from an artillery nest that had got their range. When the enemy guns finally were located, "The Mocker" was dispatched to headquarters with a message.

As the bird reached home with the note which was soon to silence the death-dealing battery, signal men found that one of its eyes was destroyed by a shell splinter. Its head was a welter of blood, but it had flown on doggedly and was the means of saving hundreds of lives.

The other war bird, "Spike," has a record of having carried fifty-two important messages under fire without suffering as much as a scratch. Most famous (Continued on page 115)

Dove Is Now Night Bird of War

Continued from page 113

of all the hero pigeons was "Cher Ami" (Dear Friend), which, its breast pierced by a bullet and one of its legs torn away, brought in the message that saved the remnant of the Lost Battalion, two hundred and fifty-two men. It survived its wounds for almost a year, returned to this country in an Army transport, and was recommended for the Distinguished Service Cross.

Its record was closely matched by that of "President Wilson," which also delivered an important message despite the loss of a leg during the intensive machine gun and artillery action at St. Mihiel. This brave bird has been preserved and placed on exhibition in the Smithsonian Institution, at Washington, D.C.

Living in perfect amity with "Spike" and "The Mocker" are the two German prisoners of war, "Wilhelm" and "Helena." The bands on the legs of these birds, which were captured at the front as they were transmitting enemy messages, revealed by the crown and crest stamped upon them that they belonged to the ex-Kaiser's own loft of prize carrier pigeons.

At the armistice, nearly 9,000 homing pigeons were in service with the A.E.F. in France. Records show that the birds functioned with a higher percentage of delivered messages than radio, telegraph, telephone, or runners. Ninety percent of all messages entrusted to American homers at the front reached their destinations. This ratio, Signal Corps experts say, will be increased to almost 100 when the new race of night flying pigeons is developed to its full extent.

Froth Smothers Biggest Oil Blaze

(Continued from page 20)

refineries, the Bayonne plant included, have stores of the fire fighting substances already dissolved in tanks, from which pipes lead to each of the oil holders. It is only necessary to turn a valve to spread the foam-producing streams into an oil tank. The portable type of machine, also used, is connected to a water hose, and cans of the chemicals in dry powder form are emptied into a hopper. The pressure which the chemicals generate shoots a foaming stream thirty or forty feet.

With the start which the fire had obtained on the near-by pier, not even the permanent foam pipes could save all the tanks. Flames which licked one of them were instantly extinguished when the valves went on, but others, eventually eighteen of them, holding some 70,000 barrels of oil, were ablaze.

While men with the portable generators braved the searing heat, their chemical supply began to run low. It was on the point of exhaustion when two trucks with a new supply, escorted by State troopers with screaming sirens, dashed in from Paulsboro, N. J.

Meanwhile another stirring scene was being enacted at Elmira, N. Y., where the chemical factory is situated. Crack express trains were held up long enough for employees working in double shifts to load cars with additional powder, more than a hundred tons of it, for Bayonne.

It was the arrival of these cans of powder that saved the refinery. When the tired fire fighters heard a welcome locomotive whistle and saw the first box car of powder roll in on a spur, they knew the fight was all but ended. They fed the powder into their generators, while floodlights pierced the growing darkness of evening and smoke. Caked with the white deposit left by the powder's spray upon helmets and clothing, they looked more like ghosts than men as they applied the finishing touches to the $3,000,000 fire.

A definite program for getting ahead financially will be found on page four of this issue.

Bowlus Teaches Me How to Glide

(Continued from page 38)

air. Then ease the stick slightly ahead."

"When do I begin turning?"

"As soon as you go over the brow of the ridge begin skidding around. The tendency is to overcontrol. Although the sailplane moves through the air slowly, its controlling surfaces are so large it responds instantly to movements of the stick and rudder pedals. The controls are just as sensitive as in a high speed airplane. On the first flight, most people move them too far."

"How about landing?"

"Fly her into the ground. Set her down hot. In a sailplane, you never make three point landings. You come down with the tail high, sliding along on the skid under the forward part of the fuselage. Never let the ship settle down in a pancake landing. There are a few rocks down there." I looked over the nose of the fuselage and thought I could count at least a million, "so you will have to pick the spot where you are going to land early."

"And then try and land there," I added.

"When you get ready, give the starting signal, and when you get in the air, use your own judgment."

"Fine. If I can use my own judgment, I won't land in that water."

BOWLUS took his place on the shock cord. I settled down in my seat, looked to see that the V was spread out evenly on each side of the nose and then called: "One, two, three, run."

The rubber V suddenly expanded. The machine slid forward ten feet and was in the air. With the wind whistling past the wings, it sailed over the heads of the launching crew. The shock cord jerked from the hook and fell to the ground. The whistling died out. For a moment the ship hung like a balloon in the air.

I glanced down. Most of the launching crew had white blobs on top—their faces looking up. But the leading runner on one leg of the V was elongated. He had tripped over a bush and was skidding down the hillside on his vest. Sometimes it is a lot safer to be in the glider. Once, at Lebec camp, I was told, Lindbergh was on the shock cord when it pulled from the hook. He did a flip-flop and sat down right on a cactus.

While I was watching the runner pick himself up, I almost forgot to ease forward the stick. When I did, the nose dropped slightly and we soared away. It was a strange sensation for an experienced airplane pilot. It was taking off with the motor stopped. I remembered the joke about Mrs. Lindbergh's flight in a Bowlus machine. Someone remarked: "So young and no motor to glide her." Well, if I got into a jam now, there would be no engine to pull me out.

I PASSED the brow of the ridge. The view opened out with a rush. The slope-bottom lay almost 700 feet below me. Time to turn. I would meet the up-currents soon. I twitched the stick cautiously to the right and pressed lightly on the right rudder pedal. The long wings banked slightly, the nose swung to the right and the ship skidded into a slow turn. Then it struck the up-currents and I received the first of many surprises.

In an airplane, an up-current means a jolt. But in a soaring craft, you are carried aloft as gently as rising on a feather bed. The nose is not thrown up as in a motored plane. The whole ship rises as though riding an elevator. There are no sudden up and down movements in soaring. The machine is lifted and lowered smoothly and gently. The sensation is entirely different from that in an airplane. You possess wings. You are actually flying. You ride the changing air currents, making friends with the bumps you hate when flying a plane.

I was climbing without effort. The ridge was slipping past as I sailed parallel to it. The visibility was perfect. The fog had disappeared. The ship answered to the slightest touch of the controls. I was flying silently high above the heads of those below. I could hear them calling to one another. I swung in a wide circle to the left. The ridge dropped behind.

This was flying as I had dreamed it would be when I watched the birds as a boy. But the dream came to an end. I circled too wide, beyond the up-currents. The ship was sinking. My mind came back to earth—to hard rocks and cold water. I still had to land.

Along the edge of the bay ran a line of telephone wires. They didn't help my peace of mind. My impression was not that I was moving toward the wires and the water. They were racing toward me. The boulders on the ground seemed to multiply like guinea pigs. I picked out the clearest spot with the best intentions in the world of landing there.

But a soaring plane glides more than twenty feet ahead for every one it descends. An airplane glides only seven or eight. Consequently my descent carried me farther than I had expected. I passed over the open space still ten feet in the air. I couldn't turn back and land with a tail wind. I had to come down straight ahead.

I PICKED out another spot and flew the plane on the ground. It touched, slid along, reached the brow of a slight roll in the land, and the up-currents there lifted it five feet into the air. For a hundred yards, we sailed only a few feet above the boulders. Again I touched and again a slight up-draft took us off the ground. The wings seemed fused with lifting gas!

The boulders were getting thicker. I knew if I kissed one head-on it would be just too bad. Out of the corner of my eye, as I bobbed from side to side to watch the boulders slip under my wings, I could see the water and the telephone poles getting nearer. But their rate of advance had slowed down. The plane was losing its speed. Before me was one more open space and then the water. I set my teeth. I was going to land in that open space if I had to fly the ship into the ground to do it. I set her down and held the stick ahead. We slid into the wind with the tail high. I wobbled the ailerons to keep the sixty foot wings level so they wouldn't hook any of the boulders. But just before we came to a stop, the right wing dragged. The ship slewed around. The tip of the aileron had snagged a rock. I felt disgraced until Bowlus told me the dented tip could be straightened in no time. I had landed a mile from my starting point.

"YOU made a beaut of a flight," he told me, and I knew he meant it.

"But how about the landing?" I asked.

"Which one?" was his comeback.

It is no exaggeration to say that first soaring flight was one of the outstanding thrills of my twenty years on the skyways. No other sensation in the world is just like it. I condensed my feeling about it into three words when Bowlus asked me how I liked soaring. Those three words were:

"'I want more!'"

Next month, Jordanoff will give more of his experiences in motorless flying. He has seen gliding grow from box kite machines to Bowlus record holders. Watch for his next article. It will contain valuable information and practical advice for all who are interested in the new sport of flying like the birds. Order your September copy in advance.

Sugar Will Give You Endurance

(Continued from page 33)

measuring the men's ability to fix their attention on a mobile object. In this experiment an instrument known as a Marietta complication clock was used. It consists of a large dial divided into 100 degrees, with a single hand revolving once a minute in other words an oversized stop watch measuring time in hundredths of a minute. At certain fixed positions of the hand, a light, placed above the clock dial, is flashed on without warning. The person taking the test must tell where the hand is pointing when the light is flashed.

How did the sugar boys compare with the saccharin boys? The group taking sugar improved 5.5 percent when its performance in the test after exercise was checked against that before exercise. The squad drinking the saccharin solution showed a loss of 9.4 percent! The performance of the first group on the last three days, when it was given saccharin, was slightly inferior to that on the first three days.

In another test, determining the speed of the subject's reaction, it was found again that the men drinking the sugar mixture had the advantage. Reaction was timed with a Marietta chronoscope, measuring time in thousandths of a second.

The student sat at a telegraph key, facing a small flashlight bulb. He was told to raise his hand from the key as quickly as possible when the light flashed. The experimenter pressed a switch, the light flashed, the student released the key, and the chronoscope recorded the speed of his reaction in thousandths of a second. What happened was that the current, flowing through the switch operating the light, also caused the time recording instrument to mark the beginning of the time interval. The student, by raising his hand from the key, opened a second circuit through which another current was flowing. This caused the chronoscope to record the end of the time interval.

DURING the first three days, the group that took sugar showed a gain in speed of 5.7 percent when the tests before and after exercise were compared, while the saccharin squad registered a loss of 2.1 percent. The first group showed a loss of 5.2 percent on the last three days, when it took saccharin, despite the fact that the men had the benefit of practice on the first three days. This experiment indicated, according to Doctor Laird, that an athlete who munches a lump or two of sugar before a race ought to break the tape ahead of a runner who does not.

Students in whom loss of sleep had caused fatigue were also tested. It was assumed that sugar would be beneficial in such cases, and experiments, Doctor Laird said, confirmed this belief. Students were kept awake all night, being fed on sugar or foods that contained sugar. It was found that their nerves did not become frayed, that they had little difficulty in remaining awake, and recuperated entirely during a thirteen-hour sleep. A second test, without the energizing sugar, showed that the subjects had difficulty keeping awake, became nervous and irritable, and at the end required more sleep to refresh themselves.

As a result of these tests, it is assumed by Doctor Laird that workers who find it necessary to stay awake for long periods can offset fatigue by the use of sugar in some form.

The standard tracing board test was used by Doctor Laird to discover what difference the use or nonuse of sugar might make in a person's steadiness of hand. Once more, the sugar squad won, with an improvement of 4.2 percent. The saccharin men showed no improvement whatever, and the first group improved only 2.1 percent on the last three days of the experiment, when it took the saccharin "cocktail" instead of the sugar.

The Talking Newspaper

(Continued from page [illegible])

These motor trucks, varying in capacity from one half ton to five tons, contain various types of recording machinery and generating apparatus, depending upon the kind of sound equipment used by the particular company. They also carry the camera and microphone which, of course, are taken off the vehicle when the operators start work, and the cables that connect camera and "mike" with the truck. Usually they are manned by a crew of three—the camera man, the sound man, and the microphone man, one of whom as a rule is also the driver.

The average cost of a completely appointed sound truck is $25,000. An idea of the investment made by the news movie companies when sound reels became the fashion may be gained from the fact that the Fox-Hearst organization alone at present has forty sound trucks in operation in this and other countries.

IN PLACES that are inaccessible to the sound truck and on what newsreel men call "emergency assignments," portable sound recording outfits are used. One cannot, for example, board a steamer with a truck. To connect a sound truck in the street by cable with, say, the twentieth floor of a building, where a celebrity to be "interviewed" may have an office, would be a cumbersome and difficult job. In such cases and at times when a distant point must be reached in a hurry and a train becomes the more desirable means of transportation, the "portable" is used.

Paramount's portable outfits weigh about 380 pounds each, those of Fox and Pathé between 200 and 250 pounds. Fox also has a "flying outfit" for airplanes which weighs scarcely 200 pounds. A complete set of portable equipment, including sound recording apparatus, camera, and microphone, is contained in three or four small cases, each about twenty inches long, twenty inches high, and eighteen inches wide, that look like a traveling man's sample grips and take up no more space. Three men can handle the outfit and it is transported easily in trains and taxicabs.

Portables, though already giving satisfactory results, are still in the experimental stage. Sound engineers are seeking constantly to improve them. Newsreel men predict that when they have been perfected to a point where the quality of their output is on a par with that of the sound trucks, they will be used exclusively and the trucks will disappear from the field. At present, the trucks are indispensable in the preparation of the talking newspaper.

Take, for example, the Ohio Penitentiary fire, the greatest disaster in the history of sound newsreels. Pathé News "shots" of which New Yorkers saw and heard twenty-one hours after the outbreak of the conflagration. The "story"—newsreel men, like newspapermen, call their subjects "stories"—was told in 800 feet of film that took only two and one half minutes to be shown on the screen. But the sound truck men who "covered" it narrowly escaped death when their sound truck, or "camion," as they call it, was struck by a high tension electric wire during a wild night drive through a storm to the scene of the disaster. Incidentally, that they were able to reach Columbus and record the fire before their competitors arrived was due entirely to the fact that they were in Cleveland, covering the opening of the American League baseball season when the prison fire broke out.

Such "scoops" are a rarity in these days of sound news. Encumbered by five-ton trucks, the camera men, as a rule, find it next to impossible to beat each other. A melancholy smile passed over the usually cheerful countenance of Harry Harde, the camera man who filmed the prison fire, as he compared present conditions with those of the past.

"In the old silent days," he said, "it was a cinch to 'steal' pictures, as we call it. We did it with a small camera that you could conceal about your person. But try and hide a sound truck!"

My interest aroused by his Ohio experience, I accompanied Harry on his next assignment. I wanted to see how it was done. As it happened, it was another prison job, but a peaceful one this time—shooting sound pictures of the Prison Keepers' School of the New York City Department of Correction at the Penitentiary on Welfare Island, in the East River, New York. Under the direction of a physical trainer, a group of rookie prison guards was exercising in the yard. The men boxed, wrestled, did jiu-jitsu.

The Pathé sound truck was parked on a walk traversing the field. It happened to be the same truck that had made the night ride to Columbus. Harry proudly showed me the nick above the driver's seat where the live wire had hit. That dent, you may be sure, will never be taken out of that truck!

The camera was mounted on its tripod in the ordinary manner and then connected by cable with the truck. The microphone, connected in the same way, was placed so as to catch the commands of the trainer. Then Harry and the sound man, at his post inside the truck, attached their transmitters and headpieces, thus establishing telephone communication with each other. Everything was set.

"Are you ready?" Harry asked the sound man over the phone. Receiving a satisfactory answer, he nodded to the trainer to proceed. The rookie guards went through their exercises, the trainer shouting directions. Harry started the motor on his camera and the sound man set the recording machinery in motion.

Pathé uses the R. C. A. Photophone system, in which pictures and sound are recorded on separate films. What happened while the scene was being shot, the sound man afterward explained to me, was this:

BOTH camera and sound recording apparatus are equipped with synchronous motors, operated from the same alternating current supply. Hence, they keep time and always pass the same footage of film. While the motion picture was being taken, the sound waves picked up by the condenser microphone were transformed into electrical impulses which were led back by cable into the truck, where they were fed into an amplifier and then into the recording machinery.

The sound recording equipment carried on a truck is essentially the same as that used in a talkie studio. The process, therefore, consists of the three usual steps: The microphone changes the sound waves into electrical impulses; the electrical impulses are translated into light vibrations, and these are exposed on film (P. S. M., Apr. '29, p. 171).

Like the sound room in a studio, the truck is not only provided with an amplifier and a recording device, but also with a volume control apparatus. Besides, it is equipped with batteries for the production of direct current, rotary converters to change it into alternating current, and transformers to deliver the current at proper voltage. It is a complete and self-sustaining unit, ready at a moment's notice, to gather sound news anywhere.

In the portable outfit, the camera and recorder are in one unit. This system is used also in the sound truck equipment of Fox and Paramount, which employ Movietone and Western Electric apparatus, respectively.

After a "story" has been shot, the film—or films in case of the double system—is rushed to the laboratory, where it is quickly developed, printed and edited. Now the subject is ready for insertion in the sound newsreels, and when this is assembled the "talking newspaper" is shipped to the theaters.

New Pipe Lines Point to Gas Heating Era

(Continued from page 34)

near a gas line betrays gas, escaping in quantity, by brown patches. If a serious break has occurred it is easy to find. The broken line, under the terrific pressure that it carries, probably will have leaped clear out of the ditch in which it was buried.

A gas transmission line is run much like a railway, and an important official at its central office is the chief dispatcher. His duty is to distribute gas at the proper pressure to all the cities of a state-wide system. Before him, electric light bulbs flash on a huge chart to indicate the open or closed position of all the valves. Meters show him the pressure in the various sections. If pressure falls too low in the Dayton supply, for example, the Ohio operator gives orders to divert more gas from some place where the pressure is high. Telephone and telegraph give him instant communication with key stations along the way.

NO LESS concerned with the weather than an aviator or a Sunday picnicker is this chief dispatcher. It takes eighteen hours for Texas gas to travel through the pipes to Kansas City, Mo., where a sudden cold snap may mean a demand for an additional hundred million cubic feet of gas in a twenty-four-hour period. So weather reports are rushed to the chief dispatcher at Bartlesville, Okla., from the U. S. Weather Bureau Station at Fort Smith, Ark., while special observers along the pipe line supplement these reports.

So has the use of gas from the earth progressed in the hundred years that it has been known and used. It is one of the oldest of fuels, and its history really begins before the nineteenth century.

George Washington was one of the first investors in natural gas property. In 1775 he visited a tract near Charleston, W. Va., where a strange "burning spring" awed sight-seers. Washington bought the property as a curiosity and presented it to the nation as a park.

Two brothers, David and Joseph Ruffner, discovered the first gas well when, in the early 1800's, they drilled a fifty-eight foot shaft for salt in the Great Kanawha Valley of West Virginia. This was thirty years before petroleum was discovered.

Although other cities were beginning to make gas in factories, Fredonia, N. Y., is said to have been the first city in the United States to use natural gas commercially. This was in 1826. Titusville, Pa., in 1872, installed the first natural gas pipe system for domestic service. There were no gas meters in those days. Companies charged for gas by counting the number of burners in use and estimating how many hours each was likely to be run. At a certain hour the night watch would strike an iron rod as a signal that it was time to turn out all gaslights.

WILL the supply of natural gas ever give out? It may some day—but new wells, it seems, are being found as fast as the old ones run out. Engineers point out that sensible business men would hardly project a gas line from Texas to Chicago if they feared that natural gas might soon be exhausted.

Where are gas companies to put gas if it cannot be pumped into a pipe and sold immediately? Within the last few years they have found a new place to keep it. They pump it back into abandoned gas or oil wells.

Both natural and manufactured gas are now pumped into these great storage reservoirs that Nature provides. More than a tenth of all the gas produced by four great California fields is being stored in this way. It would require about four hundred 20,000,000-cubic-foot gas tanks to hold as much gas as is stored underground in one Kentucky field. Very little is lost in the subterranean sands.

What Europe Can Teach Us

(Continued from page 40)

eral patents, any one of which anticipated the patent under which he was threatened. Unfortunately, however, the patents I brought him were anticipations of his own patent as well as of the threatening one. He then told me to try to find a patent of intermediate scope, meaning one which anticipated the threatening patent but not his own. This I did for him in three more days.

Note well that this entire job was done in six days and not six months or six years. If I can do this, there seems to be no good reason why a Patent Office examiner, who has become an expert in his field and who has nothing else to occupy his time, could not do as well or better.

Without rising from the swivel chair in my office, I can lay my hand on abstracts of about 40,000 magazine articles on chemistry and patents on chemical inventions published last year. By rising and taking a step or two, I am within reach of such abstracts for the last twenty years! They are well indexed and often I can tell an inventor all he wants to know about a chemical invention in five minutes.

THE United States Patent Office is the greatest publishing house in the world. There is no reason whatever why it should not provide indexes to literature published on machines and mechanical devices as complete and convenient as those on chemistry which I have in my office.

While I have been comparing United States Patent Office methods and personnel with those of Germany and England to the possible disadvantage of the United States, I must make it clear that a comparison of the patent *laws* tells an entirely different story.

The United States law gives the inventor two years to file his patent application after he has used his invention in public or published a description of it in a magazine such as Popular Science Monthly. Thus the American inventor can test out his device or process and hear it publicly criticized, and safely develop improvements as a result. This two-year delay allowed by the law, in effect, protects him.

The English or German inventor, on the other hand, must rush to the Patent Office as soon as he thinks he has made an invention, even if his ideas are only half-baked, and get his invention filed immediately, for his rights as an inventor date from the day he files his papers in the Patent Office. If he is a Swiss, his papers are even marked with the hour and minute he puts them into the hands of the officials, and his rights may turn on the difference of a single minute in getting them there. The Swiss government prints that hour and minute on the patent it gives the inventor.

THE two-year leeway is a distinct advantage to the American inventor. But it often compels the Patent Office to establish interference proceedings to determine priority of invention (P. S. M., July '30, p. 44), and these have proved a curse to many an American inventor. Interference procedure should be improved, because now it often nullifies the advantages given the inventor by the two-year leeway. But bad as interferences are for some inventors, this two-year leeway should be preserved. More often than not, the time and money spent in an interference preserve rights which otherwise would never have existed, and which do not exist in England and Germany.

Because inventions in most foreign countries date from the day and hour the application is filed, the far-sighted American inventor files his foreign applications promptly. However, many countries have joined with the United States in a treaty or "Convention" which provides that filing in any one of the so-called "convention countries" is as good as filing in any other. That is to say, if the inventor files copies of his application in any other of these countries within a calendar year of the day he files his original papers, the additional country accepts the filing date of his original papers as the date of his invention.

So, in the good old days, before delays were almost interminable in the United States Patent Office, an inventor always received an early report on the novelty of his invention, and then decided, on the basis of that report, whether to file or not to file patent applications in one or more of the 130 countries and colonies which maintain separate patent systems. He had ample time to get the examiner's report, study it, and make up his mind whether filing foreign patent applications was a good risk.

Many American inventors patent their inventions in several foreign countries. Nearly 8,000 inventors from the United States, for example, each year take out Canadian patents to protect their inventions in the Canadian market. A considerable number also take out corresponding patents in other countries, especially Germany, England, and France.

IN FOREIGN countries the laws covering patents and infringements vary. They are stringent in Mexico, where infringement is a criminal offence, punished by imprisonment. In England, the loser in an infringement suit, just as in any other British lawsuit, pays the entire litigation expenses for both sides. In the United States, the loser only forfeits what he has spent himself, except that an infringer here, of course, has to pay damages, as in all countries. It is possible in England for an infringer to pay only a few cents damages and thousands of dollars for the opponent's expenses in fighting him.

Several million dollars a year are spent by American inventors who file patent applications in foreign countries to protect their inventions. Much of this American money is wasted in attempting to protect inventions which already have been patented by others. If it were not for the delays in the United States Patent Office in passing on patent applications, a considerable proportion of this wasted money could be saved.

The oldest foreign patent of which there is a complete record is that for a pump granted to Galileo, the great Italian scientist and philosopher, while he was a professor of mathematics at the University of Padua. He applied for this patent in December, 1593. On December 28, the application reached the examiner, then called the "Purveyor of the Commune." The examiner approved the application on February 18, 1594, and Galileo received his patent on September 15 of that year, nine months after he had filed his papers.

THAT was 337 years ago. It is true that the Republic of Venice, whose doge or chief magistrate granted Galileo his patent, did not have to pass on some 1,600 patent applications a week, as has the United States Patent Office these days. The phenomenal growth of scientific knowledge in the past 300 years has been responsible for the flood of inventions now overwhelming the Patent Office. But that same knowledge can and should be used to create the machinery with which to solve the problem. Only in that way can the United States regain its lost leadership in the world of invention.

Until the much-needed reforms in the U. S. Patent Office have been effected, inventors must cope with existing conditions. In a helpful article next month, Mr. Thomas will show the best way of obtaining a patent and tell inventors what pitfalls to avoid.

Mystery Cell Aids Television

(Continued from page 17)

system used in the scanning equipment. Its shadow would then appear on the image of any object scanned by the television transmitter.

Although Hammond has said that he uses the Alexanderson system of television—which means, of course, the Alexanderson type of Karolus cell—it is hardly probable that he intends to install an arc light in the plane's television receiver. However, the new light cell could be used with any source of illumination and in an airplane, where space and weight are limited, a concentrated filament nitrogen-filled electric bulb would give adequate light for a screen of the size contemplated.

Now that the problem of producing a large and bright television image has been solved, who will be the first to find a way to produce a really sharp, clearly defined television image —and to make the receiving scanning disk always keep step with the transmitting disk? Only a short time ago these three difficult problems confronted the televisionist. One is solved. Two still remain to be conquered!

LAKE THUNDER MYSTERY BAFFLES SCIENTISTS

Strange sounds like the distant boom of guns have been heard again this year across Lake Seneca, N. Y. The "lake guns," of which examples are known all over the world, have never been satisfactorily explained. Scientists have established only the facts that they are not thunder and are not of human origin.

Under various names, they have long been studied. The Asiatic Society of Bengal first systematically observed them in 1865, near the island town of Barisal 120 miles from Calcutta, and named them "Barisal guns." Elsewhere they are known today as water guns, gouffers, fog belchers, paper fogs, and sea cannon. Italy's expert, Prof. Tito Alippi, gave them their present universally recognized scientific name of "brontidi," meaning "like thunder."

Several localities in the United States have "brontidi." Residents of Syosset, N. Y., have heard the noises. "Tremendous explosions" near Cazadero, Calif., have been identified as brontidi. A mysterious "reverberating sound in the sky, with a slight metallic resonance" heard by many visitors to the Yellowstone and Shoshone Lakes in Yellowstone National Park, Wyo., and recently described by Edwin Linton, University of Pennsylvania zoologist, may be of the same nature.

Mild earthquakes, their sounds possibly magnified in underground caverns like sound boxes, have been suggested as the origin of the noises. A more original theory is that of Dr. Elon Howard Eaton, of Hobart College. He points out that the "lake guns" are heard from the middle of Lake Seneca, which is between 500 and 600 feet deep at that point and known to be crossed by a gas belt. Perhaps, he says, there is a fissure in the bottom of the lake through which gas escapes. When it acquires enough pressure to burst through the silt, it might rush to the surface with the characteristic booming sound.

Another explanation was suggested for Yellowstone Park's thunder by Dr. F. C Marvin, Chief of the United States Weather Bureau. His theory is based on the observations of Glen Jefferson, meteorologist at Yellowstone Park, that the temperature of air over the lake often rises with increasing altitude, instead of diminishing at a normal rate of one degree for every 325 feet of altitude. This peculiar temperature inversion, Doctor Marvin suggests, may alter the normal way that the air conducts sound. It might produce sound mirages, in which distant noises of geysers, birds, or steamboats might appear to come from near at hand.

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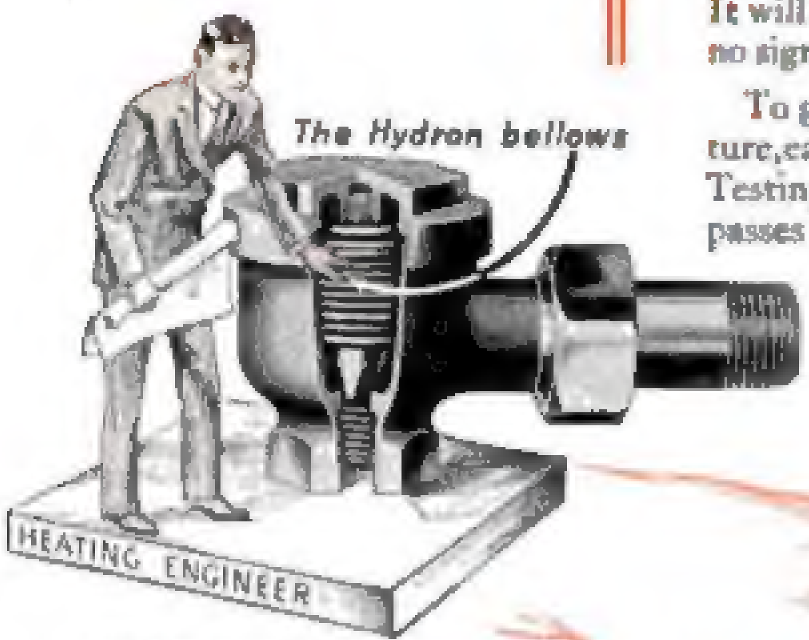

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